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# **THE METABOLIC RESPONSE OF YOUNG WOMEN TO A STANDARDIZED DIET**

Home Economics Research Report No. 16

Agricultural Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE



# **THE METABOLIC RESPONSE OF YOUNG WOMEN TO A STANDARDIZED DIET**

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Growth Through Agricultural Progress

Home Economics Research Report No. 16

Human Nutrition Research Division

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# The Metabolic Response of Young Women to a Standardized Diet

By Ruth M. Leverton, Jane M. Leichsenring, Hellen Linkswiler, Hazel Fox, and Frieda L. Meyer

## SUMMARY

To aid in the understanding of nutritional requirements and in the interpretation of nutritional data, the metabolic response of normal young women to a standardized diet was determined. Thirty college women served as subjects for a period of 20 days, the first 5 days of which they ate their self-chosen diets, followed by 15 days on a standardized diet. The study was then extended to determine the response of 15 of the subjects to altered levels of magnesium intake in the standardized diet and the response of 8 of the subjects to altered levels of pantothenic acid intake. Analyses of the intake and the excretion of nitrogen, calcium, phosphorus, magnesium, thiamine, riboflavin, pantothenic acid, and fat of each subject provided the bases for interpreting metabolic response. The summary of results is given for the 10-day period which followed a 5-day adjustment period in the standardized diet, except for magnesium and pantothenic acid when the summary includes the results on the different levels of intake.

### Nitrogen

On an intake of approximately 11 gm. of nitrogen daily, none of the 30 subjects were in negative balance. The retentions of the 30 subjects ranged from 0.36 to 2.61 gm. of nitrogen daily and averaged 1.60 gm. In this 10-day and in subsequent periods, however, one-third to over one-half of the subjects retained less than 1 gm. of nitrogen daily. The results suggest that the level of intake closely approximated the requirement for maintaining nitrogen equilibrium in this group of subjects.

### Calcium

On a mean daily calcium intake that approximated 757 mg. the balances of the 30 subjects ranged from -138 to 130 mg., and averaged zero. Fourteen of these subjects were in negative calcium balance, which indicates that this level of in-

take was not sufficient to maintain equilibrium in the entire group of subjects.

### Phosphorus

The phosphorus intake was approximately 950 mg. daily and the balances of the 30 subjects ranged from -162 to 215 mg. daily. Ten subjects were in negative phosphorus balance.

### Magnesium

The magnesium balances of the subjects on different levels of intake increased significantly as the intake increased. A mean daily intake of 183 mg. of magnesium was inadequate for maintaining equilibrium in any of the subjects who were studied on this level; an intake of 320 mg. maintained equilibrium or promoted storage in all of the subjects studied on this level. On the intermediate intakes of 274 to 282 mg., 37 percent of the subjects were in slight negative balance. The results suggest, therefore, that a daily intake of at least 280 mg. of magnesium, and perhaps more, would be needed to insure equilibrium in all of the women studied.

### Thiamine

On a daily intake of 800  $\mu$ g. of thiamine only 4 of the 30 subjects had urinary excretions large enough to meet the criteria used as indicative of adequate thiamine nutrition. Nine subjects met these criteria when they were on self-chosen diets. The estimated thiamine content of these self-chosen diets ranged from 1,100 to 1,760  $\mu$ g. daily. The urinary excretion of thiamine by the subjects on the controlled intake ranged from 26 to 213  $\mu$ g. daily, which represented from 3.8 to 27.0 percent of the intake.

### Riboflavin

The standardized diet supplied approximately 900  $\mu$ g. of riboflavin daily and the urinary excre-

tion of the subjects ranged from 56 to 242  $\mu$ g. daily, or from 5.9 to 27.8 percent of the intake. These excretion values did not consistently meet any of the criteria suggested as indicative of adequate riboflavin nutrition of the body.

### Pantothenic Acid

The intake and excretion of pantothenic acid were determined for eight of the subjects. Daily intakes of 2.8, 7.8, and 12.8 mg. resulted in mean urinary excretions of 3.1, 4.5, and 5.6 mg., re-

spectively, and the correlation coefficient of intake and urinary excretion was 0.80.

### Fat

The standardized diet supplied 90 gm. of fat daily and the fecal excretion of the subjects ranged from 1.38 to 3.48 gm. daily. The mean daily fecal excretion of fat was relatively stable for each of the subjects throughout the different periods of the study and seldom varied more than 0.5 gm.

## INTRODUCTION

Information on the requirements of human beings for the essential nutrients is needed for appraising the adequacy of available food supplies and estimating the food production necessary for satisfying nutritional needs. Interpretation of existing data on human requirements is difficult, because of the differences in the diets that have been used by workers in different laboratories for the study of the various nutrients. Such differences also complicate the task of establishing the range in response of normal individuals to a given diet. Results from a reasonably large number of subjects studied under uniform experimental conditions, especially of dietary intake, and the simultaneous measurement of the body's response to several nutrients would increase greatly the information and understanding of human requirements and the interrelationships and utilization of nutrients.

To aid in accomplishing such an objective, research workers in the Human Nutrition Research Division of the Agricultural Research Service have developed a standardized diet for metabolic studies (21).<sup>1</sup> The diet is constructed so that it is possible to maintain reasonably constant intakes of the essential nutrients from uniform sources over extended periods of time. In addition, it is possible to vary the level of one nutrient while keeping the level of all the other nutrients practically unchanged under various experimental conditions. The acceptability and practicality of the

diet were established by testing it with six young women for a period of 40 days.

With the standardized diet available as a research tool, a study was undertaken with the primary purpose of determining the range in metabolic response of a group of 30 young women to the diet and thus aid in the interpretation of nutritional data. The plan included a metabolism study of the women for a period of 20 days, the first 5 days during which they ate their self-chosen diets, followed by 15 days when they were on the standardized diet.

Another purpose was accomplished when it was possible to extend the study of 23 of the 30 women beyond the initial 20 days and determine the response of 15 of them to altered levels of magnesium intake, and the response of 8 of them to altered levels of pantothenic acid intake. These extensions contributed to the overall study of normal ranges in metabolic response.

The investigation was carried out in four nutrition research laboratories in the Home Economics Departments of the Universities of Alabama, Minnesota, and Nebraska, and the Oklahoma State University. The work at each location was supported in part by a U.S. Department of Agriculture contract sponsored by the Human Nutrition Research Division.

<sup>1</sup> Italic numbers in parentheses refer to Literature Cited, page 29.

## PROCEDURE

### Subjects

The number of women who served as subjects at each location, and the duration and dates of the study were as follows:

Alabama	6 women	20 days	November 1 to 20, 1955
Minnesota	7 women	35 days	January 10 to February 13, 1957
Nebraska	8 women	40 days	February 10 to March 21, 1956
Oklahoma	9 women (1 subject did not complete the last 20 days)	40 days	February 6 to March 16, 1956

The code number, age, and certain physical measurements of each subject are given in table 1. Age ranged from 18 to 24 years, weight from 47.3 to 73.2 kilograms, height from 158.1 to 177.8 centimeters, surface area from 1.46 to 1.89 square meters, and basal metabolic rate from 1,159 to 1,534 Calories per 24 hours. According to the recent table of weight for height prepared by Hathaway (12), 24 of the 30 subjects were within 10 percent of the expected median weight, and 6 between 11 and 15 percent. Of these 6 subjects, the weights of 4 were above, and 2 below the expected median weight. Basal metabolic rates for 21 of the subjects were within 10 percent of the standard proposed by Boothby, Berkson, and Dunn (5), 5 subjects were 11 to 15 percent below,

TABLE 1.—*Description of subjects*

State and subject code number	Age <sup>1</sup>	Weight		Height	Surface area <sup>3</sup>	Basal metabolic rate	
		Initial	Devia- tion <sup>2</sup>			Total per 24 hours	Devia- tion <sup>4</sup>
	<i>Years</i>	<i>Kilograms</i>	<i>Percent</i>	<i>Centi- meters</i>	<i>Square- meters</i>	<i>Calories</i>	<i>Percent</i>
<b>Alabama:</b>							
101.....	23	58.1	-4	163.8	1.63	1,159	-18
102.....	21	54.5	-2	159.4	1.55	1,282	-5
103.....	21	52.2	-6	162.6	1.55	1,238	-8
104.....	21	64.4	-1	175.3	1.78	1,447	-6
105.....	21	60.1	-2	168.3	1.69	1,320	-10
106.....	20	64.6	-14	164.5	1.70	1,306	-12
Average.....		59.0		165.6	1.65	1,292	
<b>Minnesota:</b>							
201.....	18	61.8	-9	165.1	1.68	1,358	-8
202.....	20	55.0	-2	163.8	1.59	1,392	-1
203.....	19	48.1	-8	158.1	1.46	1,267	-2
204.....	19	54.5	-4	165.1	1.59	1,375	-2
205.....	21	53.4	-14	173.4	1.64	1,409	-1
206.....	20	61.6	0	172.7	1.73	1,534	-2
207.....	19	47.3	-11	159.4	1.46	1,411	-10
Average.....		54.5		165.4	1.59	1,392	
<b>Nebraska:</b>							
301.....	19	47.3	-10	158.7	1.46	1,314	-2
302.....	21	49.8	-6	158.7	1.49	1,193	-8
303.....	24	73.2	-14	175.9	1.89	1,511	-8
304.....	18	57.3	0	165.7	1.63	1,388	-3
305.....	19	56.0	-4	167.0	1.62	1,418	-1
306.....	23	68.9	-9	174.6	1.83	1,394	-12
307.....	19	63.6	-6	170.8	1.74	1,378	-10
308.....	20	62.3	-6	168.3	1.71	1,213	-18
Average.....		59.8		167.5	1.67	1,351	
<b>Oklahoma:</b>							
401.....	19	63.9	-1	176.5	1.79	1,430	-9
402.....	22	60.7	-7	177.8	1.76	1,328	-13
403.....	20	64.9	-4	174.0	1.78	1,483	-4
404.....	21	63.4	-11	165.9	1.70	1,210	-18
405.....	21	56.2	-3	161.3	1.58	1,260	-8
406.....	20	71.4	-15	173.5	1.85	1,373	-14
407.....	22	63.7	-7	169.4	1.73	1,260	-16
408.....	21	57.8	-5	171.4	1.68	1,395	-4
409.....	20	60.5	-3	173.5	1.73	1,327	-12
Average.....		62.5		171.5	1.73	1,341	
Average for all subjects.....	20	59.2		167.8	1.67	1,346	

<sup>1</sup> To nearest birthday.<sup>2</sup> From tables for ages 20-24 by Hathaway (12).<sup>3</sup> Calculated from the formula of DuBois and DuBois (8): Area (sq. cm.) = Wt. kg.  $0.425 \times$  Ht. cm.  $0.725 \times 71.84$ .<sup>4</sup> From standards proposed by Boothby, Berkson, and Dunn (5).

and 4 subjects were 16 to 18 percent below this suggested standard.

The women were judged to be in good health on the basis of thorough medical examinations.

The subjects at the University of Alabama were housed together. On the other three campuses the subjects lived in their usual residences and had headquarters for dining and daytime activities in the nutrition research laboratories.

## Standardized Diet

The standardized diet developed and tested in the nutrition research laboratories of the Agricultural Research Service is a combination of ordinary foods which provides palatable meals but low levels of most of the nutrients. The diet is then supplemented with synthetic and purified products, so that the total intake provides adequate levels of

essential nutrients. These levels were not planned to include the margins of safety provided by the recommended allowances of the Food and Nutrition Board of the National Academy of Sciences, National Research Council (25), because high nutrient intakes may mask individual differences in metabolic response or alter interrelationships among nutrients.

The term "reference" is used to designate these adequate levels and to distinguish them from the modified or altered levels of certain nutrients which are used later in the study.

TABLE 2.—*Estimated nutritive value of the standardized diet*

Nutrient	Core	Complement I	Complement II	Reference
Food energy-----calories--	550	1,450	0	2,000
Nitrogen-----grams--	3.2	7.8	0	11
Fat-----do--	10	80	0	90
Carbohydrate-----do--	100	150	0	250
Calcium-----milligrams--	150	50	500	700
Phosphorus-----do--	300	300	400	1,000
Magnesium-----do--	65	17	148	230
Iron-----do--	4	2	4	10
Copper-----do--	0.6	0.2	0	0.8
Iodine-----do--	0.090	0.015	0	0.105
Manganese-----do--	1	1	0	2
Potassium-----do--	900	200	1,000	2,100
Sodium-----do--	300	Trace	2,100	2,400
Zinc-----do--	3	1	0	4
Vitamin A value— International units--	1,000	1,500	1,500	4,000
Vitamin D-----do--			400	400
Ascorbic acid-----milligrams--	10		50	60
Thiamine-----do--	0.15	0.15	0.5	0.8
Riboflavin-----do--	0.3	0.2	0.5	1.0
Niacin-----do--	5	2	0	7
Folic acid-----micrograms--	25	25	50	100
Pantothenic acid-----milligrams--	2	1	1	4
Pyridoxine-----do--	0.3	Trace	0.5	0.8
Choline-----do--	120	80	100	300
Cobalamin (B <sub>12</sub> )-----micrograms--	1		4	5

The estimated nutritive value of the standardized diet with the reference levels of nutrients is shown in table 2. The diet consists of three components: (1) A "core" made up of natural and refined foods which forms the nucleus for the meals; (2) complement I composed of refined foods, primarily to bring food energy and protein to desired levels; and (3) complement II composed of mineral salts and purified vitamins to provide these nutrients at reference levels. It was in complement II that the modifications were made when other than reference levels of magnesium or pantothenic acid were used in the present study.

The kinds and amounts of foods in the core and complement I and their distribution into meal patterns are shown in table 3. Meal patterns were used in the following order for successive 5-day periods: Pattern 1, 2, 1, 2, and 3. Adjustments were made in the amounts of sugar and jelly used for different subjects in order to meet the calorie requirement of each subject and maintain her at a constant weight. Distilled water and instant coffee and instant tea, made with distilled water, and sodium chloride were allowed ad lib. A record was kept of the tea and coffee intake.

TABLE 3.—*Meal patterns and amounts of foods per person per day in the standardized diet*

Items	Pattern 1	Pattern 2	Pattern 3
<b>CORE:</b>			
<b>Breakfast:</b>	<i>Grams</i>	<i>Grams</i>	<i>Grams</i>
Applesauce, canned-----	100	100	100
Farina, unenriched (dry weight)	20		
Rice Krispies, <sup>1</sup> unenriched-----		15	
Cheerios, <sup>1</sup> unenriched-----			10
Evaporated milk-----	25	25	25
<b>Lunch:</b>			
Rice, precooked, unenriched (dry weight)-----	25		25
Spaghetti, unenriched (dry weight)-----		25	
Tomato puree-----	30	30	30
Lettuce-----	20	20	20
Pears and juice, canned-----	100		100
<b>Dinner:</b>			
Beef (raw weight) <sup>2</sup> -----	45	45	
Haddock, frozen fillet (raw weight) <sup>2</sup> -----			50
Potato, precooked and dried (dry weight)-----	25	25	25
Green beans, frozen (cooked weight)-----	100		100
Celery, frozen (thawed weight)-----		60	
Peaches and juice, canned-----		100	
<b>COMPLEMENT I:</b>			
Rolls, weighed as dough (casein, gluten and cake flour, sugar, fat)-----	250	250	250
Cookies, weighed as dough (cake flour, sugar, fat)-----	75	25	75
Dough for cobbler (peach) (cake flour, sugar, fat)-----		65	
Butterfat-----	45	45	45
Sugar <sup>3</sup> -----	5	5	5
Jelly, grape and apple <sup>3</sup> -----	30	30	30
Gelatin, granulated-----	2	2	2

<sup>1</sup> Mention of specific products does not imply recommendation by the U.S. Department of Agriculture over others of a similar nature not mentioned.

<sup>2</sup> Amounts adjusted to supply approximately 1.6 gm. nitrogen.

<sup>3</sup> Amounts adjusted to take care of individual calorie requirements.

TABLE 4.—*Calculated fat and fatty acid content of the standardized diet*

Source of fat	Total fat	Selected fatty acids			
		Total saturated	Total unsaturated	Oleic	Linoleic
From foods:					
Evaporated milk.....	Grams 2.0	Grams 1.10	Grams 0.78	Grams 0.66	Grams 0.06
Beef.....	1.4	.67	.66	.62	.03
Flour (cake, gluten).....	2.0	.28	1.52	.62	.84
Cereals:					
Farina, spaghetti.....	.2	.03	.15	.06	.08
Cheerios <sup>1</sup> .....	.1	.02	.07	.03	.04
Subtotal.....	5.7	2.10	3.18	1.99	1.05
From added fat:					
Hydrogenated fat <sup>2</sup> .....	23	10.33	12.67	9.78	2.60
Butterfat <sup>3</sup> .....	60	33.00	23.40	19.80	1.80
Total.....	88.7	45.43	39.25	31.57	5.45

<sup>1</sup> See footnote 1, table 3.<sup>2</sup> Used in preparation of rolls, tomato puree, meat-potato.<sup>3</sup> 15 gm. used in preparation of cookies and cobbler, 45 gm. as table fat.

The preparation of foods and the recipes used were the same as have been described in Section III of Meyer and others (21), except for a few changes.<sup>2</sup>

Cereals, cake flour, gluten flour, casein, instant potato, spaghetti, rice, and the vitamins and gelatin capsules were each purchased in one lot and distributed to the four laboratories. This was true also for the hydrogenated fat, which was a commercial product made from meat and vegetable fats. Specified brands of canned and frozen foods were secured locally. The total quantity of these needed for the duration of the study in each location was purchased at one time. The celery was purchased locally and blanched and frozen for use throughout the study. Lettuce, of course, had to be purchased fresh as needed.

Butterfat was prepared at each laboratory and was used in the cookies and cobbler dough and as table fat. Hydrogenated fat was used in the preparation of the tomato puree and rolls and in

cooking the meat or fish. The calculated fatty acid content (11) of the diet is shown in table 4.

The calculated amino acid content (28) is shown in table 5 and compared with requirements of the amino acids as summarized in the report of the Food and Nutrition Board (26). The diet contained 19 mg. of niacin equivalence (12 from tryptophan and 7 from niacin), using the suggested figures of 60 mg. of tryptophan equivalent to 1 mg. of niacin (25).

TABLE 5.—*Calculated amino acid content of the standardized diet and suggested requirements and proportionality pattern*

Amino acids	In standardized diet	Food and Nutrition Board	
		Minimal requirements for women	Proportionality pattern (tryptophan=1)
	Grams	Milligrams	
Isoleucine.....	3.034	450	2.9
Leucine.....	4.813	620	3.8
Lysine.....	2.618	500	3.2
Methionine.....	1.204	350	2.2
Cystine.....	1.009	200	1.3
Total sulfur A.A.....	2.213	550	3.5
Phenylalanine.....	3.176	220	1.4
Tyrosine.....	1.985	900	5.7
Total aromatic A.A.....	5.161	1,120	7.1
Threonine.....	2.035	305	1.9
Tryptophan.....	.722	157	1.0
Valine.....	3.206	650	4.1

<sup>2</sup> The changes in food preparation from that described by Meyer and others (21) were as follows:

The inner white stalks of green celery were used at three locations, because bleached celery was not available.

Tomato juice was used in the tomato puree, because the canned tomatoes were likely to contain a calcium salt.

Beef was packaged and frozen in individual portions rather than in the total amount needed for a meal.

The amount of butterfat was increased from 35 to 45 gm. per person per day.

The amount of magnesium gluconate added to the rolls was increased to supply approximately 148 mg. instead of 100 mg. of magnesium.

The amounts of vitamins and minerals added in purified form in Complement II are shown in table 2. One-third of the day's supply of the B vitamins was given in solution at each meal. Thiamine, riboflavin, pyridoxine, and choline were dissolved in 0.02 N acetic acid, and calcium pantothenate, folic acid, and cobalamin were dissolved in water. Ascorbic acid was given in a gelatin capsule with the breakfast, as was another gelatin capsule containing the vitamin A and D concentrate. The calcium diphosphate was given in a capsule with every meal. The iron, magnesium, and potassium salts were added to the water used in the preparation of the roll dough.

Changes in the magnesium or in the pantothenic acid content of the standardized diet were made by altering the amount of the nutrient in Complement II.

## Sequence of Periods and Levels of Intake

The length of the study at each location was divided into consecutive periods of 5 days each and designated A, B, C, D, etc., through Period H. During the first 5 days of the study, Period A, the subjects were on their customary self-chosen diets. They recorded their food consumption in estimated household measures and these records were used for calculating the nutritive value of the self-chosen diets.

Beginning with the sixth day, the first day of Period B, and continuing until the end of the study, all of the subjects were fed the standardized diet. Period B, the first 5 days that the subjects were on the standardized diet, was considered a transition or adjustment period, and the intake and excretion values are not included in the calculations of subsequent means or in the regression equations. Following Period B, the subjects were kept on the same level of intake for at least two periods or 10 days.

The levels of certain nutrients in the standardized diet for the different periods were as follows:

PERIODS B, C, AND D.—All of the subjects were on the standardized diet with the intake of nutrients designated as "reference levels." These levels of the nutrients for which the diet was analyzed at each location are shown in table 6.

TABLE 6.—*Analyzed values for standardized diet used at four locations* (Per person per day)

Nutrient	Ala- bama	Minne- sota	Nebras- ka	Okla- homa
Nitrogen-----grams--	10. 64	11. 40	11. 06	11. 16
Fat-----do-----	86. 40	89. 70	92. 30	87. 90
Calcium---milligrams--	703	742	728	830
Phosphorus-----do----	938	976	942	936
Magnesium-----do----	252	320	274	247
Thiamine_micrograms--	741	832	790	786
Riboflavin-----do----	970	949	872	891

PERIODS E AND F.—The magnesium intake of the 7 Minnesota subjects was reduced from 320 to 238 mg. daily. The magnesium intake of Oklahoma subjects 401, 403, 405, 407, and 409 was decreased from 247 to 180 mg. daily; while the intake of subjects 402, 404, and 406 was increased to 280 mg. (Subject 408 did not continue with the study after Period D.)

The pantothenic acid intake of Nebraska subjects 301, 302, 303, and 304 was increased to 7.8 mg.; while the intake of subjects 305, 306, 307, and 308 was increased to 12.8 mg.

PERIODS G AND H.—The Minnesota subjects were continued through Period G on the same levels as in Periods E and F. However, the Oklahoma subjects were "switched," so that each subject received the alternate level of magnesium which was being studied there. The odd-numbered subjects received 280 mg. daily and the even-numbered subjects, 180 mg.

The Nebraska subjects were also switched, so that subjects 301 to 304 received 12.8 mg. of pantothenic acid and subjects 305 to 308 received 7.8 mg.

## Collection and Preservation of Materials

The materials collected and preserved for analysis throughout this metabolic study included food, urine, and feces. Aliquots of food were collected for the group at each location beginning with the standardized diet in Period B. Collections of urine and feces, however, began with the first day of Period A.

FOOD.—A composite was made of the core foods used in each 5-day period. The foods were combined in a Waring Blendor and made into a slurry with 0.1 N HCl. Portions from each lot or recipe of rolls, of cookies, and of cobbler were treated similarly. For the pantothenic acid determinations made in the Nebraska study, duplicate composites were made without the HCl as a preservative. All slurries were stored at  $-20^{\circ}\text{C}$ .

URINE.—Glacial acetic acid to give a final concentration of 2 percent was added to the urine collections. Completeness of 24-hour collections of urine was checked by determination of creatinine, then the collections for each subject were made into a 5-day composite. An aliquot of this composite was stored at  $-20^{\circ}\text{C}$ . and used later for thiamine and riboflavin determinations. A second aliquot, preserved with 10-percent HCl, was stored at room temperature and used for nitrogen and mineral analyses. In the Nebraska study a portion of each urine collection was preserved with toluene for the determination of pantothenic acid.

FECES.—A capsule containing 300 mg. of carmine was given to each subject before breakfast at the beginning of each 5-day period to mark the feces. Each fecal collection was either frozen as soon as possible or acidified with 10 percent by weight of acetic acid and refrigerated. The 5-day composite was blended with water and aliquots

TABLE 7.—*Summary of constituents determined, materials analyzed, and methods used*

Constituent and method	Material analyzed			Reference
	Food	Urine	Feces	
Creatinine, Colorimetric		x		Clark and Thompson (7).
Nitrogen, Volumetric	x	x	x	Assoc. Off. Agr. Chem.—Kjeldahl-Gunning-Arnold (2). Markely and Hann (16).
Fat, Gravimetric	x		x	A.O.A.C. Acid hydrolysis (2). Modified by treating with yeast to ferment out the sugar.
Calcium, <sup>1</sup> Volumetric	x	x	x	Ingols and Murray (14).
Phosphorus, <sup>1</sup> Colorimetric	x	x	x	Fiske and Subbarow (9).
Magnesium, <sup>1</sup> Colorimetric	x	x	x	Orange and Rhein (27).
Thiamine, Fluorometric	x	x		Assoc. Vitamin Chem., Inc.—Methods of Vitamin Assay (3). Mickelsen, Condiff, and Keys (22).
Riboflavin, Fluorometric	x	x		Assoc. Vitamin Chem., Inc.—Methods of Vitamin Assay (3). Najjar (24), and Slater and Morrell (30), Meyer <i>et al.</i> —Modification (21).
Pantothenic acid, Microbiological	x			Zook, MacArthur, and Toepfer (32): Free and total pantothenic acid. Free pantothenic acid.

<sup>1</sup> Material was dry ashed below 550° C., A.O.A.C. (2).

were taken for the determination of fat. Another aliquot was acidified with 10-percent HCl and used for nitrogen and mineral analyses. All aliquots were stored at -20° C.

## Analytical Methods

The methods which were used for analysis of the food, urine, and feces are summarized in table 7. The details are described by Meyer and others (21). A Farrand or Coleman photofluorometer was used for the fluorometric readings and a DU Beckman spectrophotometer, Coleman spectrophotometer, or Evelyn colorimeter for all colorimetric readings.

## RESULTS

The results of the metabolic study will be presented first for the constituents determined in the intake, urine, and feces—nitrogen, calcium, phosphorus, and magnesium; and then for the constituents determined in the intake and the urinary excretion only—thiamine, riboflavin, and pantothenic acid; and finally for the constituent determined in the intake and the fecal excretion only—fat. Urinary creatinine values will accompany the nitrogen figures. The text and tables will deal chiefly with mean values for all of the subjects studied, or for the subjects at each location. In some instances the mean value for the excretion or retention of the subjects at one

## Calculation of Nutritive Value of Self-Chosen Diets

Tables of Watt and Merrill (31) were the chief source of figures of food composition used in calculating the nutritive value of the 5-day self-chosen diets which had been recorded by the subjects in estimated household measures of servings. When necessary, figures were used from the tables of Bowes and Church (6). The magnesium content of the diets was calculated from figures given by McCance and Widdowson (18, 19), supplemented by those of Sherman (29). The pantothenic acid content was calculated from the figures given by Zook and others (32).

location was found to be significantly different from the mean for the subjects at another location. Such differences among normal, healthy young women, however, were not considered to have significance for the objectives of this study, inasmuch as its primary purpose was to determine the range in the metabolic response of normal individuals to a standardized diet.

Results for the two 5-day periods C and D, when the intakes remained unchanged, have been averaged and a mean value given for the 10 days designated as "Periods CD." The data for Periods E and F, and for Periods G and H have been averaged similarly and the values designated

TABLE 8.—NITROGEN: *Mean and standard deviation for intake, excretion, and balance for subjects in each State and for all subjects during different periods*

State, number of subjects, and period	Intake		Urine		Feces		Balance		Range in bal- ances	Subjects in nega- tive balance
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation		
Alabama—6 subjects:	<i>Grams</i> 12.87	<i>Grams</i> 1.00	<i>Grams</i> 8.51	<i>Grams</i> 1.40	<i>Grams</i> 1.24	<i>Grams</i> 0.11	<i>Grams</i> 3.12	<i>Grams</i> 1.69	<i>Grams</i> 0.75 to 5.68	<i>Number</i> 0
A-----	10.65	.05	8.84	1.28	.92	.19	.89	1.16	-1.37 to 1.97	1
B-----	10.64	.03	8.64	.60	.96	.15	1.03	.49	.64 to 1.66	0
CD-----										
Minnesota—7 subjects:										
A-----	11.39	2.01	8.36	1.49	.90	.33	2.13	.76	.65 to 3.08	0
B-----	10.86	.10	9.11	.29	1.09	.14	.66	.34	.28 to 1.10	0
CD-----	12.08	.09	9.15	.29	.79	.17	2.14	.28	1.74 to 2.60	0
EF-----	11.04	.11	9.34	.33	.81	.23	.89	.36	.34 to 1.28	0
G-----	11.03	.10	9.29	.33	.89	.20	.84	.33	.45 to 1.41	0
Nebraska—8 subjects:										
A-----	13.11	2.96	10.32	1.36	.97	.28	1.82	2.58	-3.52 to 4.27	1
B-----	11.00	.06	9.88	.74	.95	.38	.17	.87	-1.41 to 1.12	3
CD-----	11.06	.06	9.49	.37	.81	.20	.76	.34	.36 to 1.24	0
EF-----	11.00	.06	9.50	.33	.77	.28	.73	.27	.20 to 1.10	0
GH-----	11.04	.07	9.32	.22	.87	.16	.86	.21	.64 to 1.22	0
Oklahoma—9 subjects:										
A-----	14.42	2.63	9.48	.83	1.41	.33	3.53	2.26	1.10 to 8.14	0
B-----	11.01	.00	7.11	.40	.81	.33	3.09	.48	2.27 to 3.70	0
CD-----	11.16	.00	7.89	.25	.95	.16	2.31	.25	1.84 to 2.61	0
EF—8 subjects	10.41	.16	8.38	.45	1.02	.13	1.01	.42	.39 to 1.52	0
GH—8 subjects	10.51	.04	8.33	.24	1.03	.11	1.19	.30	.76 to 1.69	0
All States:										
A—30 subjects	13.05	2.51	9.25	1.44	1.14	.35	2.66	2.05	-3.52 to 8.14	1
B—30 subjects	10.90	.15	8.66	1.30	.94	.29	1.31	1.41	-1.37 to 3.70	4
CD—30 subjects	11.24	.51	8.76	.74	.88	.18	1.60	.77	.36 to 2.61	0
EF—23 subjects	10.81	.32	9.06	.62	.87	.24	.88	.36	.20 to 1.52	0
GH—16 subjects	10.78	.28	8.82	.56	.95	.15	1.02	.30	.64 to 1.69	0

as results for "Periods EF" and "Periods GH." Because of the desirability of including in the results the averages for the same number of days at each location, figures for Period G in the Minnesota study were not averaged with those for Periods EF or with the results for Periods GH from other locations.

The results obtained for each subject for each 5-day period throughout the study are given in appendix table 26.

## Nitrogen

The mean and standard deviation of the intake, excretion and balance of nitrogen for the subjects at each location, and for all subjects, during different periods are summarized in table 8. Also shown are the ranges in the nitrogen balances and the number of subjects in negative balance during each period.

The coefficients of variation for the intake, excretion and balance for all of the subjects studied in different periods are shown in table 9.

TABLE 9.—NITROGEN: *Mean, standard deviation, and coefficient of variation for retention*

Number of subjects	Period	Mean daily retention	Standard deviation	Coefficient of variation
		<i>Grams</i>		<i>Percent</i>
30-----	CD	1.60	0.77	48
23 <sup>1</sup> -----	CD	1.72	.77	45
23-----	EF	.88	.36	41
16 <sup>2</sup> -----	CD	1.53	.85	55
16-----	EF	.87	.37	43
16-----	GH	1.02	.30	30

<sup>1</sup> Minnesota, Nebraska, and Oklahoma subjects; subject 408 omitted.

<sup>2</sup> Nebraska and Oklahoma subjects; subject 408 omitted.

The nitrogen intakes recorded for Period A are the calculated protein intakes divided by the factor 6.25. The self-chosen food intake of the 30 subjects supplied a mean of  $13.05 \pm 2.51$  gm. of nitrogen daily and the estimated mean retention for the group was  $2.66 \pm 2.05$  gm. The daily intakes ranged from 6.12 to 18.90 gm. and the retentions on these two extremes of intake represented also the range in the retentions of the 30 subjects, namely—3.52 and 8.14 gm., respectively. (Appendix table 26.)

When the subjects went onto the standardized diet, the controlled nitrogen intakes of 10.65 to 11.01 gm. were lower for 24 of the subjects than had been provided by their self-chosen diets. The 4 subjects who went into negative balance in Period B were among these 24. The coefficient of variation in the retentions increased from 77 percent in Period A to 108 percent in Period B.

After Period B there were no negative nitrogen balances among the 30 women. During Periods CD the mean daily retention ranged from 0.36

gm. of nitrogen for subject 303 to 2.61 for subject 407, and the mean for the 30 subjects was  $1.60 \pm 0.77$  gm. on a mean intake of  $11.24 \pm 0.51$  gm. The coefficient of variation in the retentions of the subjects dropped from 108 percent in Period B to 48 percent for Periods CD.

The mean nitrogen retention decreased for 15 of the 23 subjects who were continued on the standardized diet after Periods CD, but remained quite constant for the other 8 subjects.

The nitrogen balances of the individual subjects for the different periods on the standardized diet are shown graphically in figure 1. The noticeable reduction in the variability among the subjects as the length of time increased on the controlled intake is indicated in table 9. Considering all of the subjects studied, the coefficient of variation for the nitrogen retention was 48 percent for the 30 subjects in Periods CD, 41 percent for the 23 subjects in Periods EF, and 30 percent for the 16 subjects continued through Periods GH.

Also given in table 9 are the mean balance, standard deviation, and coefficient of variation for only the 23 subjects in Periods CD who were studied through Periods EF, and for the still smaller group of 16 subjects who were studied through Periods EF and GH. For the 16 subjects who were studied the longest time, 30 days on the standardized diet, the standard deviation of the mean balance decreased steadily from Periods CD to EF to GH. When these values were calculated for the group of 23 subjects who were studied in Periods EF as well as in CD, there was only a slight reduction in variability.

The results of measuring the nitrogen balance of these 30 subjects indicate that following an adjustment period of 5 days (Period B), a daily intake of 11.24 gm. of nitrogen for 10 days, Periods CD, was sufficient to permit daily retentions ranging from 0.36 to 2.61 gm. for the individual subjects. During the next 10 days, Periods EF, when the nitrogen intake was 10.81 gm. for 23 of these 30 subjects, the range in retention was reduced to 0.20 to 1.52 gm., with a mean of 0.88 gm. A third 10-day period, Periods GH, for 16 of the subjects resulted in the range in response being further reduced to 0.64 to 1.69 gm., with a mean retention of 1.02 gm. (table 8).

In each 10-day period one-third to over one-half of the subjects retained less than 1 gm. of nitrogen daily, 10 of the 30 subjects in Periods CD, 13 of the 23 subjects in Periods EF, and 8 of the 16 subjects in Periods GH. This would suggest that in planning diets for similar nutrition studies, a daily nitrogen intake of less than 11 gm. for healthy young women might result in some negative balances among the subjects.

## Creatinine

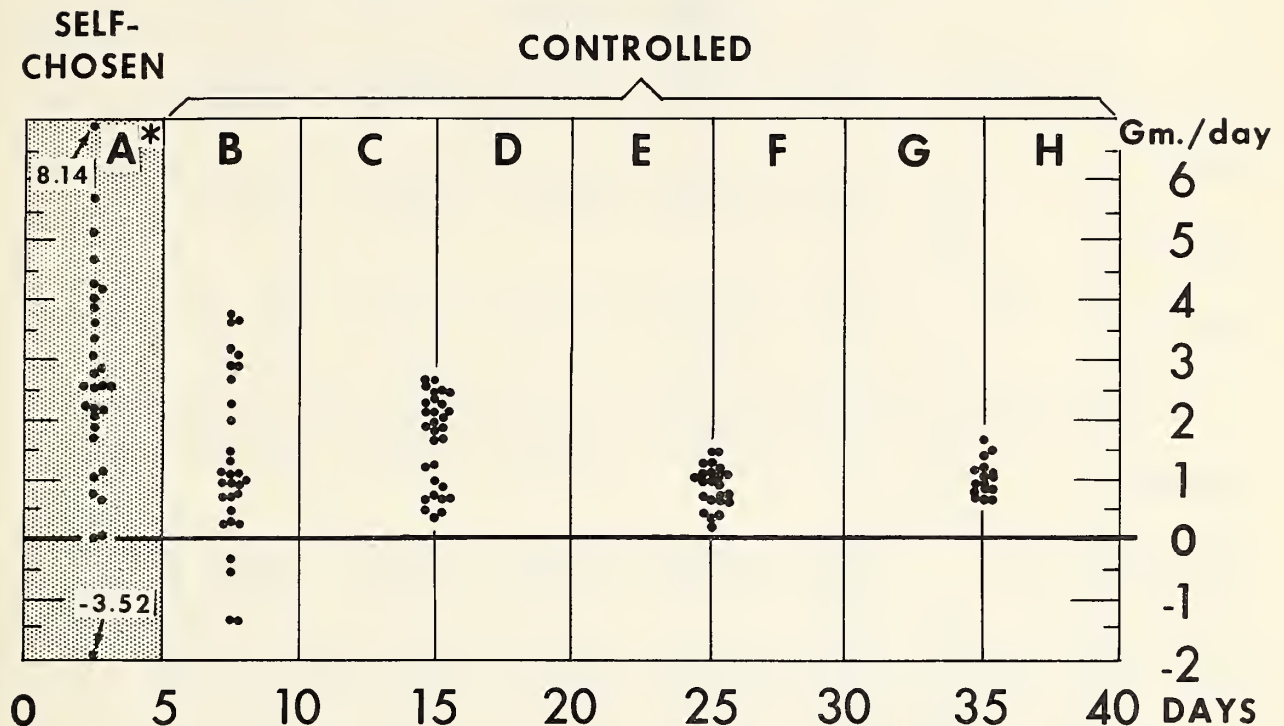
The mean creatinine values for the different periods are shown in table 10 expressed on the basis of the grams excreted per person per 24 hours, and as milligrams per kilogram of body

TABLE 10.—CREATININE: *Mean, standard deviation, and coefficient of variation of total excretion and excretion per kilogram of body weight, and ratio of urinary nitrogen to total creatinine for different periods*

Period	Subjects	Total excretion per 24 hours			Excretion per kilogram of total weight per 24 hours			Ratio of urinary nitrogen to creatinine		
		Mean	Standard deviation	Coefficient of variation	Mean	Standard deviation	Coefficient of variation	Mean	Standard deviation	Coefficient of variation
A-----	Number	Grams	Grams	Percent	Milli-grams	Milli-grams	Percent			Percent
B-----	30	1.35	0.24	18	22.7	3.2	14	6.98	1.12	16
CD-----	30	1.27	.19	15	21.5	2.2	10	7.00	1.51	22
EF-----	30	1.17	.10	9	19.9	1.7	9	7.53	.83	11
GH-----	23	1.21	.10	8	20.6	2.0	10	7.52	.74	10
	16	1.21	.11	9	19.8	1.4	7	7.33	.74	10

# NITROGEN BALANCE

## Variability on Controlled Diet for 35 Days



\*SELF-CHOSEN DIET, NITROGEN CONTENT CALCULATED.

EACH LETTER REPRESENTS A 5-DAY PERIOD.

FIGURE 1.

weight. The two sets of values exhibit similar patterns. The means and coefficients of variation decreased from Period A to Periods CD and then remained about the same from Periods EF to Periods GH.

The range in individual creatinine excretion values was greatest in Period A—from 0.92 to 1.79 gm. per 24 hours, and six subjects (all in Oklahoma) excreted more than 1.60 gm. daily. Subject 403, who had the highest excretion—1.79 gm. of creatinine—was not the largest subject but she had the highest calculated nitrogen intake for Period A—18.9 gm. Subject 401 with a creatinine excretion of 1.73 gm., the second highest among the subjects, however, had a daily nitrogen intake of only 10.9 gm. In general, the creatinine, excretions decreased when the subjects were on the standardized diet. In Periods CD and subsequent periods, the range in daily values was from 0.93 to 1.41 gm. The subject who had the smallest total excretion of creatinine also had the smallest excretion per kilogram. The subject who had the largest total excretion had the largest excretion per kilogram.

Also given in table 10 is the ratio of the urinary nitrogen to the creatinine excretion for the

different periods. This ratio increased from Period A to Periods CD and then remained relatively constant. The higher coefficient of variation in Period B is a result of four subjects having been in negative nitrogen balance during that 5-day period.

### Calcium

The mean and standard deviation of the daily intake, excretion, and balance of calcium for the subjects in each location, and for all subjects, during the successive periods are presented in table 11. Also shown are the ranges in the balances and the number of subjects in negative balance. The calcium balance of each subject for these periods is charted in figure 2.

The calculated calcium intakes of the 30 subjects during Period A ranged from 495 to 1,372 mg. daily, with a mean of 1,000 mg. daily. The mean estimated calcium retention was 48 mg., but 12 of the subjects were in negative balance.

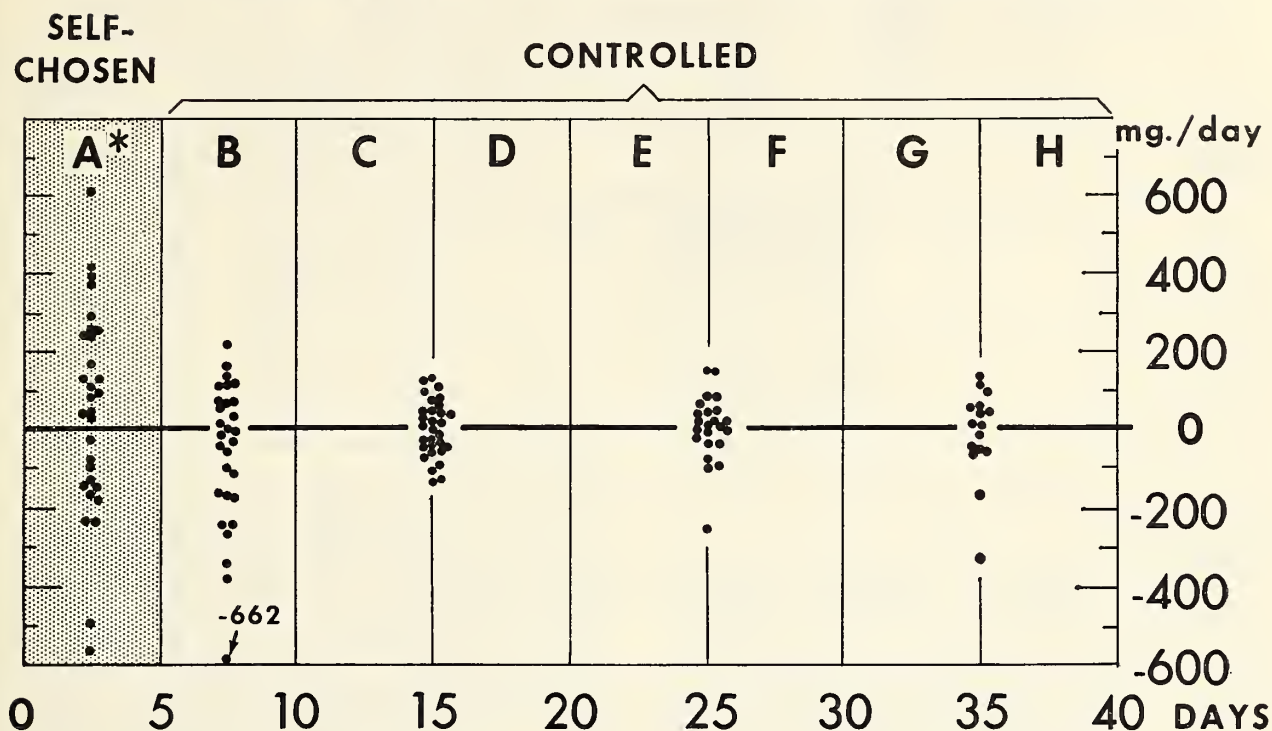
The mean daily intake and balance of calcium during Period B on the standardized diet was 742 and -62 mg., respectively. This intake was a decrease from the self-chosen diets for 25 of the 30 subjects. Of these 25, 12 went from a state

TABLE 11.—CALCIUM: Mean and standard deviation for daily intake, excretion, and balance for subjects in each State and for all subjects during different periods

State, number of subjects, and period	Intake		Urine		Feces		Balance		Range in balances	Subjects in negative balance
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation		
Alabama—6 subjects:	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Number
A-----	958	230	194	74	768	174	-4	165	-186 to 259	3
B-----	703	-----	145	58	529	37	29	51	-13 to 113	2
CD-----	703	1	149	54	553	62	1	50	-60 to 72	3
Minnesota—7 subjects:										
A-----	1,017	284	136	64	689	288	192	221	-75 to 605	1
B-----	722	-----	123	48	781	249	-182	241	-662 to 28	6
CD-----	742	-----	133	54	581	96	29	71	-58 to 130	3
EF-----	736	-----	132	49	617	117	-13	122	-250 to 158	4
G-----	718	-----	130	57	700	89	-112	68	-249 to -53	7
Nebraska—8 subjects:										
A-----	976	287	200	48	646	174	131	222	-228 to 395	2
B-----	718	-----	170	48	604	210	-57	214	-389 to 218	4
CD-----	728	-----	184	51	565	79	-21	84	-138 to 106	3
EF-----	726	-----	183	49	519	104	24	71	-74 to 150	3
GH-----	730	1	177	47	633	101	-81	117	-326 to 38	6
Oklahoma—9 subjects:										
A-----	1,036	194	187	56	951	253	-102	314	-562 to 412	6
B-----	806	-----	242	80	599	217	-34	158	-286 to 165	5
CD-----	830	3	185	57	685	99	-5	78	-126 to 120	5
EF-----	836	6	196	42	629	119	11	84	-106 to 134	3
GH-----	828	4	177	60	597	85	55	55	-2 to 96	1
All States:										
A—30 subjects-----	1,000	239	180	62	772	247	48	261	-562 to 605	12
B—30 subjects-----	742	43	175	75	629	212	-62	189	-662 to 218	17
CD—30 subjects-----	757	50	165	56	592	92	0	72	-138 to 130	14
EF—23 subjects-----	767	51	172	52	587	113	8	90	-250 to 158	10
GH—16 subjects-----	779	51	177	52	615	92	-13	113	-326 to 96	7

# CALCIUM BALANCE

## Variability on Controlled Diet for 35 Days



\*SELF-CHOSEN DIET, CALCIUM CONTENT CALCULATED.

EACH LETTER REPRESENTS A 5-DAY PERIOD.

FIGURE 2.

of storing calcium in Period A into one of losing calcium in Period B. Of the 5 subjects who had increased calcium intakes in Period B, as compared with Period A, 3 subjects changed from a negative balance in Period A to a positive balance in Period B.

In Periods CD the mean daily calcium intake was 757 mg., and the balances ranged from -138 to 130 mg. daily, with a mean of zero and a standard deviation of 72 mg. Of the 30 subjects 14 were in negative calcium balance which ranged from -138 to -1 mg. daily. The slightly different calcium intakes at the four locations, ranging from 703 mg. in Alabama to 830 mg. in Oklahoma, did not appear to affect materially the mean balances of the subjects. Both the Alabama and the Oklahoma women had a mean balance of less than 1 percent of the intake and approximately one-half of the subjects at each of these locations were in negative balance. This was true also of the mean balance for the other 15 subjects.

The proportion of the ingested calcium that was excreted in the urine and in the feces was similar when food supplied all of the calcium in Period A and when calcium diphosphate supplied two-

thirds or more of the calcium in the standardized diet.

The coefficients of variation for the intake and excretion of calcium for the different periods are shown in table 12. There was little reduction in the variability among subjects in urinary or fecal calcium excretion in successive periods on the standardized diet. The wide range from negative to positive calcium balances which resulted in the

TABLE 12.—CALCIUM: *Coefficient of variation for intake and excretion*

Period	Sub- jects	Coefficient of variation		
		Intake	Urine	Feces
	Number	Percent	Percent	Percent
A-----	30	24	34	32
B-----	30	6	43	34
CD-----	30	7	34	15
EF-----	23	7	30	19
GH-----	16	7	29	15

TABLE 13.—CALCIUM AND PHOSPHORUS: *Effect of magnesium intake on mean daily balances*

State and period(s)	Daily magnesium intake	Subjects	Daily balance			
			Calcium		Phosphorus	
			Mean	Standard deviation	Mean	Standard deviation
Oklahoma:	<i>Milligrams</i>		<i>Milligrams</i>	<i>Milligrams</i>	<i>Milligrams</i>	<i>Milligrams</i>
CD.....	248	All 9 subjects.....	-5	78	168	148
EF.....	180	401, 403, 405, 407, 409.....	11	84	143	32
	280	402, 404, 406.....				
GH.....	180	402, 404, 406.....	55	55	126	27
	280	401, 403, 405, 407, 409.....				
EF-GH.....	180	All 8 subjects.....	25	100	144	35
EF-GH.....	280	All 8 subjects.....	41	33	125	22
Minnesota:						
CD.....	320	All 7 subjects.....	29	71	130	51
EF.....	232	All 7 subjects.....	-13	122	-8	96
G.....	232	All 7 subjects.....	-112	68	-40	54

large standard deviations of the mean balances makes coefficients of variation for the balances meaningless.

Following Periods CD, the daily magnesium intake was altered for the Oklahoma and Minnesota subjects. Because some of the Oklahoma subjects were receiving more magnesium than others in Periods EF and in Periods GH, figures are given in table 13 to show the mean calcium balances (and phosphorus balances) on the different magnesium intakes. Similar data are shown for the Minnesota subjects for Periods EF and Period G.

The mean calcium balance of the Oklahoma subjects was -5 mg. daily in Periods CD and improved slightly in subsequent periods irrespective of the magnesium level of the diets. When the magnesium intake was 180 mg., the mean daily calcium retention was 25 mg. and three subjects were in negative calcium balance. When the magnesium intake was increased to 280 mg., the mean calcium retention increased to 41 mg., and no subject could be considered in negative calcium balance (the -2 mg. recorded for one subject is less than 0.25 percent of the intake). The difference between the mean balances was not statistically significant. The smaller standard deviation of the mean when the magnesium intake was 280 mg. may have been due in part to 5 of these 8 subjects having been on the standardized diet for a longer time.

The lower magnesium intake of the Minnesota subjects in Periods EF and G was accompanied by a decrease in mean calcium balance from 29 mg. in Periods CD to -13 mg. in Periods EF, to -112 mg. in Period G. Only this latter change was statistically significant.

The Nebraska subjects were maintained on the same magnesium as well as calcium intakes through Periods EF and GH, and the mean

calcium balances for them varied from -21 mg. in Periods CD to 24 mg. in Periods EF, to -81 mg. in Periods GH. When the six 5-day periods are combined, the mean daily calcium balance over the 30 days was -26 mg. Five of the 8 subjects were in negative balance. (See table 11.)

It is apparent, therefore, that the changes in calcium and phosphorus balances which occurred when the magnesium intake was altered were not consistent. In several instances such changes were no greater than occurred during different periods when the magnesium intake was kept constant.

The range in the responses of these subjects to the daily calcium intakes of 703 to 836 mg. indicates that these amounts are not sufficient to maintain calcium equilibrium in a group of young women similar to the subjects in this study. The overall range of the daily calcium balances was 268 mg. (from -138 to 130 mg.) in Periods CD, 408 mg. (from -250 to 158 mg.) in Periods EF, and 422 mg. (from -326 to 96 mg.) in Periods GH. Two subjects were in much greater negative balance than the other subjects—subject 201 who had a daily calcium balance of -250 mg. in Periods EF and subject 306 who had a balance of -326 mg. in Periods GH. Disregarding these two subjects reduces the overall range in calcium response from 408 to 264 mg. (-106 to 158 mg.) for Periods EF, and from 422 to 268 mg. (-172 to 96 mg.) for Periods GH. The extent of these ranges is the same as for Periods CD, 268 mg. (table 11).

## Phosphorus

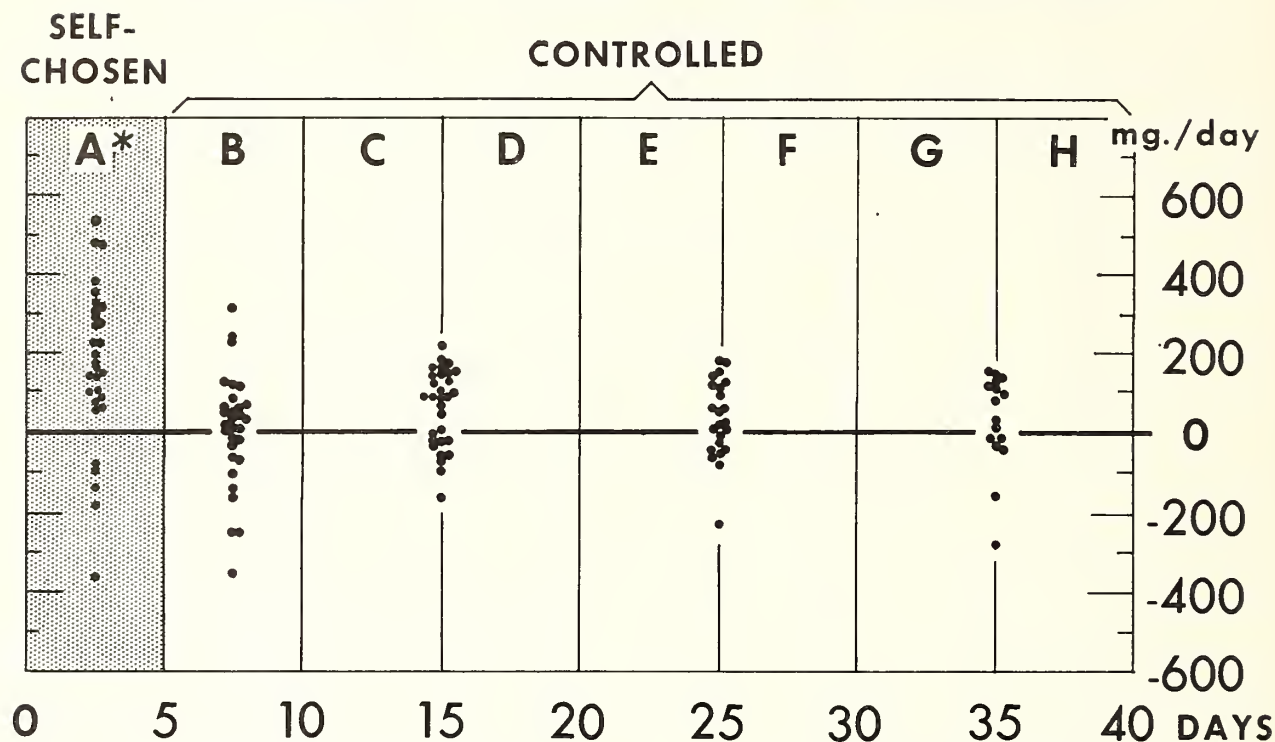
In table 14 are presented the figures for the mean daily phosphorus intake, excretion, and balance for the subjects in each location and for all subjects for successive periods, together with the ranges in balances and the number of subjects in negative balance. The coefficients of variation

TABLE 14.—PHOSPHORUS: Mean and standard deviation for daily intake, excretion, and balance for subjects in each State and for all subjects during different periods

State, number of subjects, and period	Intake		Urine		Feces		Balance		Range in balances	Subjects in negative balance
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation		
Alabama—6 subjects:	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Number
A-----	1,322	206	698	141	476	62	148	189	—184 to 329	1
B-----	938	---	496	78	388	58	54	84	—105 to 123	1
C D-----	938	---	520	84	416	52	2	64	—95 to 90	3
Minnesota—7 subjects:										
A-----	1,308	319	684	143	429	153	195	111	77 to 388	0
B-----	991	---	573	32	493	124	—75	136	—352 to 36	5
C D-----	1,039	---	549	53	359	22	130	50	80 to 215	0
E F-----	976	---	573	36	411	90	—8	96	—220 to 60	2
G-----	982	---	586	35	436	27	—40	54	—120 to 34	5
Nebraska—8 subjects:										
A-----	1,350	295	775	105	432	98	142	267	—359 to 481	2
B-----	959	---	615	81	421	130	—77	122	—241 to 66	4
C D-----	942	---	560	74	419	104	—36	73	—162 to 98	7
E F-----	954	1	586	40	365	66	—4	53	—78 to 69	3
G H-----	945	1	534	65	468	141	—57	103	—271 to 32	6
Oklahoma—9 subjects:										
A-----	1,408	242	711	133	506	126	191	231	—131 to 532	2
B-----	901	---	468	70	315	134	118	116	—14 to 311	1
C D-----	936	2	449	78	339	72	148	30	90 to 188	0
E F—8 subjects-----	925	11	445	45	337	67	143	32	96 to 188	0
G H—8 subjects-----	920	6	468	53	326	71	126	27	85 to 159	0
All States:										
A—30 subjects-----	1,352	259	719	128	462	115	171	203	—359 to 532	5
B—30 subjects-----	945	34	537	89	400	131	8	142	—352 to 311	11
C D—30 subjects-----	962	42	516	84	380	77	66	98	—162 to 215	10
E F—23 subjects-----	951	22	533	76	369	77	49	95	—220 to 188	5
G H—16 subjects-----	933	14	501	67	397	129	35	119	—271 to 159	6

# PHOSPHORUS BALANCE

## Variability on Controlled Diet for 35 Days



\* SELF-CHOSEN DIET, PHOSPHORUS CONTENT CALCULATED.

EACH LETTER REPRESENTS A 5-DAY PERIOD.

FIGURE 3.

for the intake and excretion of phosphorus are given in table 15. The phosphorus balance of each subject for these periods is shown in figure 3.

The calculated daily phosphorus intakes for Period A ranged from 763 to 1,844 mg. and averaged 1,352 mg. The mean estimated retention was 171 mg. daily. Only 5 subjects were in negative balance and 4 of them had intakes below 1,200 mg. and the fifth subject had an unusually high excretion.

TABLE 15.—PHOSPHORUS: *Coefficient of variation of intake and excretion*

Period	Subjects	Coefficient of variation		
		Intake	Urine	Feces
	Number	Percent	Percent	Percent
A-----	30	19	18	25
B-----	30	4	17	33
CD-----	30	4	16	20
EF-----	23	2	14	21
GH-----	16	1	13	33

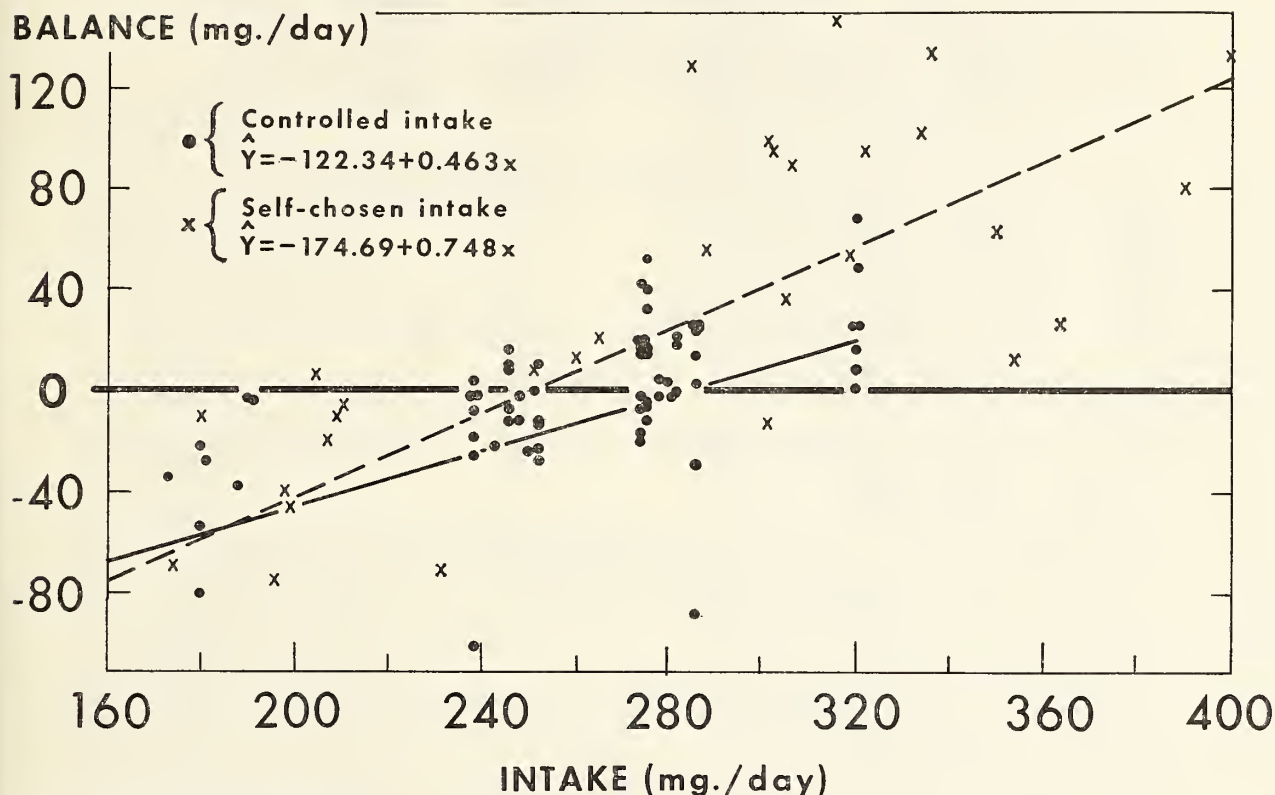
The standardized diet supplied approximately 30 percent less phosphorus than had been calculated for the self-chosen diets in Period A, 945 mg. as compared with 1,352 mg., but only 11 of the 30 subjects went into negative phosphorus balance in Period B. In Periods CD the mean daily retention for the 30 subjects was 66 mg. of phosphorus, with 10 subjects in negative balance. In Periods EF and GH the mean retention dropped to 49 mg. and 35 mg., respectively, and a smaller proportion of the subjects were in negative balance.

The standard deviations of the mean retentions were always much greater than the means and did not decrease progressively with successive periods on the standardized diet.

In general, a higher percentage of ingested phosphorus was excreted in the feces during the periods on the standardized diet when two-fifths or more of the phosphorus was supplied by calcium diphosphate, than in Period A when all of the phosphorus was supplied by food. The increases in fecal phosphorus were substantial for all of the subjects except those in Oklahoma. Their consistently higher retention of phosphorus while on the standardized diet may indicate that they were able to absorb

# INTAKE AND BALANCE OF MAGNESIUM

## Controlled and Self-Chosen Diets



Source: Leverton and others (15).

FIGURE 4.

phosphorus from the calcium diphosphate more efficiently than subjects at the other locations. None of the Oklahoma subjects were in negative balance after Period B; in general, they had a lower urinary excretion and a lower fecal excretion of this mineral than the other subjects. Also variability among the Oklahoma subjects, as indicated by the standard deviations of the mean retentions, was less than for the subjects at the other locations. This "location" difference in the phosphorus results was not evident in the nitrogen and calcium results.

The changes in magnesium intake for the Oklahoma subjects did not affect their phosphorus retentions (table 13). In the Minnesota subjects, however, there was a significant drop from a mean phosphorus retention of 130 mg. in Periods CD, when the magnesium intake was 320 mg. daily, to -8 mg. of phosphorus in Periods EF and to -40 mg. in Period G, when the magnesium intake was 232 mg. (table 13).

The range in the response of the subjects to the controlled phosphorus intake of approximately 950 mg. daily was similar to that for calcium. There were, however, somewhat fewer negative phosphorus than calcium balances. The results

suggest that 950 mg. of phosphorus daily is not sufficient to maintain equilibrium in a group of young women similar to the subjects in this study. The extent of the overall range in the phosphorus balances was 377 mg. (-162 to 215 mg.) for Periods CD, 408 mg. (-220 to 188 mg.) for Periods EF, and 430 mg. (-271 to 159 mg.) for Periods GH. As with calcium, subject 201 in Periods EF and subject 306 in Periods GH had a much larger negative balance than the other subjects. Omitting them from the calculation of the overall range reduces the extent of the range to 266 and 313 mg. for Periods EF and GH, respectively, as compared with the range of 377 mg. for Periods CD. (See table 14.)

### Magnesium

The mean daily intake and balance of magnesium for the subjects in each State and for all subjects during different periods are shown in table 16, together with the ranges in balances and the number of subjects in negative balance. The magnesium balance of each subject on each level of intake on which she was studied is charted in figure 4 for both the controlled and the self-chosen

TABLE 16.—MAGNESIUM: *Mean and standard deviation for daily intake, excretion, and balance for subjects in each State and for all subjects during different periods*

State, number of subjects, and period	Intake		Urine		Feces		Balance		Range in balances	Subjects in negative balance
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation		
Alabama—6 subjects:	Milli-grams	Milli-grams	Milli-grams	Milli-grams	Milli-grams	Milli-grams	Milli-grams	Milli-grams	Milligrams	Number
A-----	244	46	95	19	130	11	19	39	-11 to 96	2
B-----	252	---	95	26	141	19	16	23	-8 to 47	2
CD-----	252	---	106	21	157	27	-11	14	-28 to 10	4
Minnesota—7 subjects:										
A-----	263	64	96	18	162	52	4	70	-71 to 147	4
B-----	292	---	110	15	211	30	-29	34	-98 to 2	6
CD-----	320	---	123	12	169	24	28	23	2 to 68	0
EF-----	238	---	112	14	148	34	-22	36	-101 to -2	6
G-----	233	---	118	15	157	12	-43	22	-77 to -15	7
Nebraska—8 subjects:										
A-----	275	54	91	20	135	30	48	85	-69 to 129	2
B-----	260	---	95	17	151	44	14	49	-54 to 71	3
CD-----	274	---	101	16	163	29	9	21	-16 to 42	3
EF-----	275	---	105	15	154	30	16	23	-12 to 52	3
GH-----	286	---	102	15	184	43	---	40	-87 to 26	2
Oklahoma—9 subjects:										
A-----	317	76	76	12	188	36	53	72	-75 to 134	2
B-----	251	---	87	13	141	40	23	34	-21 to 66	3
CD-----	247	2	85	12	166	18	-5	14	-24 to 16	6
EF <sup>1</sup> 1—8 subjects	183	6	88	12	128	31	-33	25	-80 to -3	8
GH <sup>2</sup> 2—8 subjects	280	3	100	14	174	15	5	10	-6 to 22	3
All States:										
A—30 subjects	279	65	88	18	156	42	34	65	-75 to 147	10
B—30 subjects	263	17	96	19	160	45	7	40	-98 to 71	14
CD—30 subjects	272	29	102	20	164	24	5	23	-28 to 68	13

<sup>1</sup> Includes subjects 401, 403, 405, 407, and 409 for Periods EF and subjects 402, 404, and 406 for Periods GH.

<sup>2</sup> Includes subjects 401, 403, 405, 407, and 409 for Periods GH and subjects 402, 404, and 406 for Periods EF.

TABLE 17.—MAGNESIUM: *Regression of intake on excretion and balance*

Regression	Number of observations	b <sup>1</sup>	Proportion of variation explained by magnesium intake <sup>2</sup>
Controlled magnesium intake, mg./day on—			
Urinary excretion, mg./day	53	<sup>3</sup> 0.22	22
Fecal excretion, mg./day	53	<sup>3</sup> .32	20
Retention, mg./day	53	<sup>3</sup> .46	44
Self-chosen magnesium intake, mg./day on—			
Urinary excretion, mg./day	30	.04	2
Fecal excretion, mg./day	30	.21	11
Retention, mg./day	30	<sup>3</sup> .75	57

<sup>1</sup> Change in excretion or retention for an increase of 1 mg. per day intake of magnesium.

<sup>2</sup> Square of correlation coefficient.

<sup>3</sup> Significant at 1-percent level.

diets. The values for Period G in Minnesota and Periods E through H in Nebraska were omitted from the statistical treatment and from figure 4, in order to keep the length of time on each intake the same for all subjects.

No significant difference was found in the magnesium retention of the subjects in the four locations when analysis of covariance was employed to adjust for differences in intake. Variation in retention among subjects was not reduced when intake and retention were calculated on the basis of per kilogram of body weight.

Results of regression analyses are shown in table 17. The equation and the line for regression

of intake on balance are given in figure 4 for the controlled intakes and for the calculated self-chosen intakes. Magnesium excretion and balance increased significantly as intake increased. Because only 20 to 22 percent of the variation in excretion is explained by differences in the controlled intake, intake cannot be considered a good predictor of excretion. It can be used to help predict retention, however, inasmuch as 44 percent of the variation in retention values during periods of controlled intake is explained by differences in intake.

The regression values for Period A must be interpreted cautiously, because the magnesium intake was calculated from records of food intake estimated in terms of household measures rather than by quantitative analysis of actual intake. There was, however, a highly significant relationship between intake and retention, and 57 percent of the variation in retention was explained by differences in intake. The calculated magnesium content of the self-chosen diets ranged from 174 to 400 mg. daily. Ten subjects had intakes below 250 mg. and 9 of them were in negative balance. Of the 20 subjects with daily intakes above 250 mg., only one was in negative balance.

In table 18 the data have been grouped on the basis of the controlled levels of magnesium intake on which the subjects were studied. Both urinary and fecal excretion as well as retention increased directly with intake. Coefficients of variation for intake and excretion were stable for each group of magnesium intakes. Coefficients of variation for retention were about 80 percent for the low daily intake of 173 to 191 mg., and the high daily intake of 320 mg. of magnesium, and were about 200 percent for the two intermediate intake groups. Thus, there is little doubt about daily intakes from 173 to 191 mg. being inadequate, or

TABLE 18.—MAGNESIUM: *Mean, standard deviation, and coefficient of variation for daily intake, excretion, and balance for all subjects grouped according to intake*

Intake per day (milligrams) and subjects	Statistic	Intake	Urine	Feces	Balance
		<i>Milligrams</i>	<i>Milligrams</i>	<i>Milligrams</i>	<i>Milligrams</i>
173-191—8 subjects	Mean	183	88	128	-33
	Standard deviation	6	12	31	26
	Coefficient of variation (%)	(3)	(14)	(24)	(77)
233-252—22 subjects	Mean	245	99	158	-12
	Standard deviation	6	19	26	24
	Coefficient of variation (%)	(2)	(19)	(17)	(196)
274-282—16 subjects	Mean	277	101	170	7
	Standard deviation	3	15	23	16
	Coefficient of variation (%)	(1)	(15)	(14)	(223)
320—7 subjects	Mean	320	123	169	28
	Standard deviation	0	12	24	23
	Coefficient of variation (%)	0	10	14	83
173-320—53 subjects	Mean	255	101	158	-4
	Standard deviation	40	18	29	28
	Coefficient of variation (%)	(16)	(18)	(18)	(675)

# URINARY EXCRETION OF THIAMINE

## Variability on Controlled Diet for 35 Days

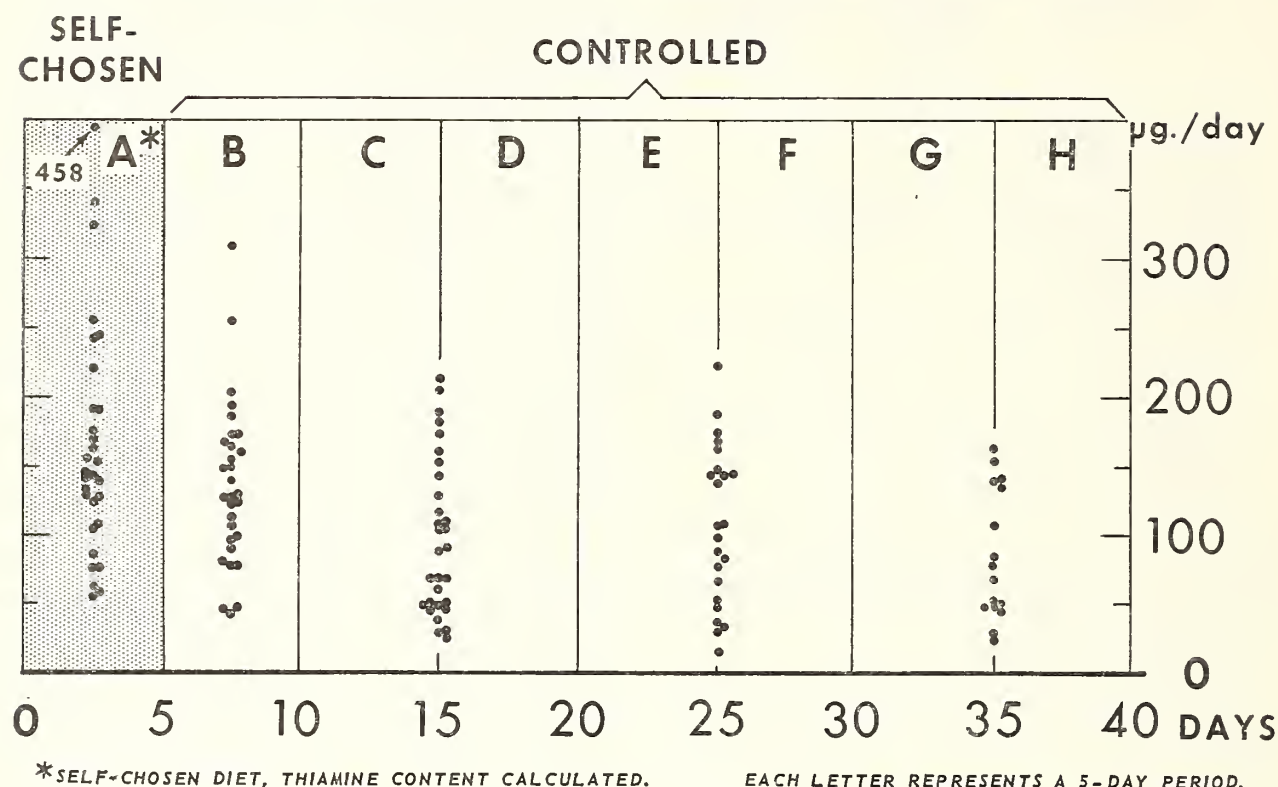


FIGURE 5.

about an intake of 320 mg. being adequate, for maintaining magnesium equilibrium in these subjects. Six, or 37 percent, of the 16 subjects who had daily intakes between 274 and 282 mg. of magnesium were excreting slightly more than they were taking in, but the extent of their negative balances was slight. Three of the six subjects had daily balances of -2 mg. and the other three had balances of -6, -16, and -20 mg. of magnesium daily.

The magnesium balances obtained during the periods of controlled intake suggest that a daily intake of at least 280 mg. of magnesium, and perhaps more, would be needed to insure equilibrium in a group of subjects similar to those in the present study. The data on magnesium have been presented in detail by Leverton and others (15).

### Thiamine

The mean daily intake and urinary excretion of thiamine for the subjects in each State and for all of the subjects during different periods are given in table 19. The urinary excretion of each subject for the different periods is shown graphically in figure 5.

The calculated thiamine content of the self-selected diets of the 30 girls ranged from 640 to 1,760 µg. per day, with a mean of 1,203 µg. The urinary excretion of thiamine during this period ranged from 56 to 458 µg. daily, and the mean was 167 µg.

In the different States the standardized diet supplied from 741 to 832 µg. of thiamine per day in Periods CD. The intake was relatively constant at each location, beginning with Period B and continuing until the end of the study. These intakes were lower than those in Period A for 27 of the 30 subjects and resulted in a decrease in the urinary excretion of thiamine for 22 of these 27 women. The three subjects who had higher thiamine intakes on the standardized diet than in Period A also had higher urinary excretions in Period B.

The mean daily urinary excretion of the individual subjects ranged from 26 to 213 µg. of thiamine in Periods CD, from 19 to 214 µg. in Periods EF, and from 24 to 164 µg. in Periods GH. The values seemed to fall into two groups. During Periods CD the mean daily values for the 15 subjects studied in Alabama and Oklahoma

TABLE 19.—THIAMINE: *Mean and standard deviation for daily intake and urinary excretion for subjects in each State and for all subjects during different periods*

State, number of subjects, and period	Intake		Urine	
	Mean	Standard deviation	Mean	Standard deviation
Alabama—6 subjects:	<i>Micrograms</i>	<i>Micrograms</i>	<i>Micrograms</i>	<i>Micrograms</i>
A-----	1,053	106	113	46
B-----	741	-----	81	30
CD-----	741	-----	60	18
Minnesota—7 subjects:				
A-----	992	251	162	56
B-----	832	-----	146	19
CD-----	832	-----	123	26
EF-----	852	-----	135	33
G-----	839	-----	120	30
Nebraska—8 subjects:				
A-----	1,200	328	235	116
B-----	774	-----	187	73
CD-----	790	-----	160	52
EF-----	719	-----	149	44
GH-----	750	-----	123	38
Oklahoma—9 subjects:				
A-----	1,470	199	146	83
B-----	775	1	123	44
CD-----	786	-----	53	26
EF—8 subjects-----	756	13	47	21
GH-----	761	5	49	18
All States:				
A—30 subjects-----	1,203	299	167	91
B—30 subjects-----	781	31	137	59
CD—30 subjects-----	789	31	101	56
EF—23 subjects-----	769	58	109	57
GH—16 subjects-----	755	6	86	47

ranged from 26 to 103  $\mu\text{g.}$  and averaged 56  $\mu\text{g.}$ , as compared with a range of 62 to 213  $\mu\text{g.}$  and a mean of 143  $\mu\text{g.}$  for the other 15 subjects, those in Minnesota and Nebraska. The difference was statistically significant at the 1-percent level. In subsequent periods the urinary thiamine excretions of most of the subjects did not deviate greatly from what they had been in Periods CD. Six subjects in Nebraska had markedly lower values in Periods GH than in Periods CD; these subjects were the ones who had the highest excretions in Periods CD, from 142 to 213  $\mu\text{g.}$  of thiamine.

Alteration in the intake of magnesium for Minnesota and Oklahoma subjects and of pantothenic acid for Nebraska subjects following Periods CD did not appear to affect thiamine excretion.

The 24-hour urinary excretion of thiamine has been used as a basis for evaluating nutritional

status of the body with respect to thiamine. The criteria suggested as indicative of adequate thiamine nutrition are (1) a 24-hour excretion of at least 100  $\mu\text{g.}$  of thiamine (Mason and Williams, 17); (2) an excretion of at least 13 percent of the thiamine intake (Giff and Hauck, 10; Melnick, Field, and Robinson, 20); and (3) an excretion of at least 150  $\mu\text{g.}$  of thiamine per gram of creatinine excreted (Adamson and others, 1).

In table 20 values are given for the mean daily urinary excretion of thiamine of the subjects for different periods expressed as per 24 hours, percentage intake, and per gram of creatinine excreted. Few subjects met all three of these criteria for adequate thiamine nutrition—9 in Period A, 4 in Periods CD, 2 in Periods EF, and none in Periods GH. In Period A when the calculated intakes ranged from 640 to 1,760  $\mu\text{g.}$  of thiamine daily, only 6 subjects excreted less than 100  $\mu\text{g.}$  of thiamine, but this number rose to 15 subjects in Periods CD when the intakes ranged from 741 to 832  $\mu\text{g.}$  daily. Less than 13 percent of the thiamine intake was excreted by 14 of the subjects in Period A and 16 subjects in Periods CD. More subjects failed to meet the criteria of excreting at least 150  $\mu\text{g.}$  of thiamine per gram of creatinine than failed to meet either of the other two criteria. In Periods A and CD, 20 and 25 subjects, respectively, excreted less than 150  $\mu\text{g.}$  of thiamine per gram of creatinine.

The wide range in the urinary excretion of thiamine, sometimes exceeding tenfold, among the subjects on the standardized diet, together with the small proportion of subjects who met the criteria indicative of adequate thiamine nutrition, suggests that the daily intake of thiamine, approximately 800  $\mu\text{g.}$ , was too low to be considered adequate for all subjects. The recommended daily allowance for thiamine is 1,200  $\mu\text{g.}$  for young women 25 years of age with an energy requirement of 2,300 Calories. The thiamine intakes of the 9 subjects who met all 3 criteria for adequate thiamine nutrition during Period A on their self-chosen diets ranged from 1,100 to 1,760  $\mu\text{g.}$  daily and averaged 1,357  $\mu\text{g.}$

## Riboflavin

Mean values for the riboflavin intake and urinary excretion for the subjects in each State and for all subjects during different periods are given in table 21. The values for each subject during successive periods are shown in figure 6.

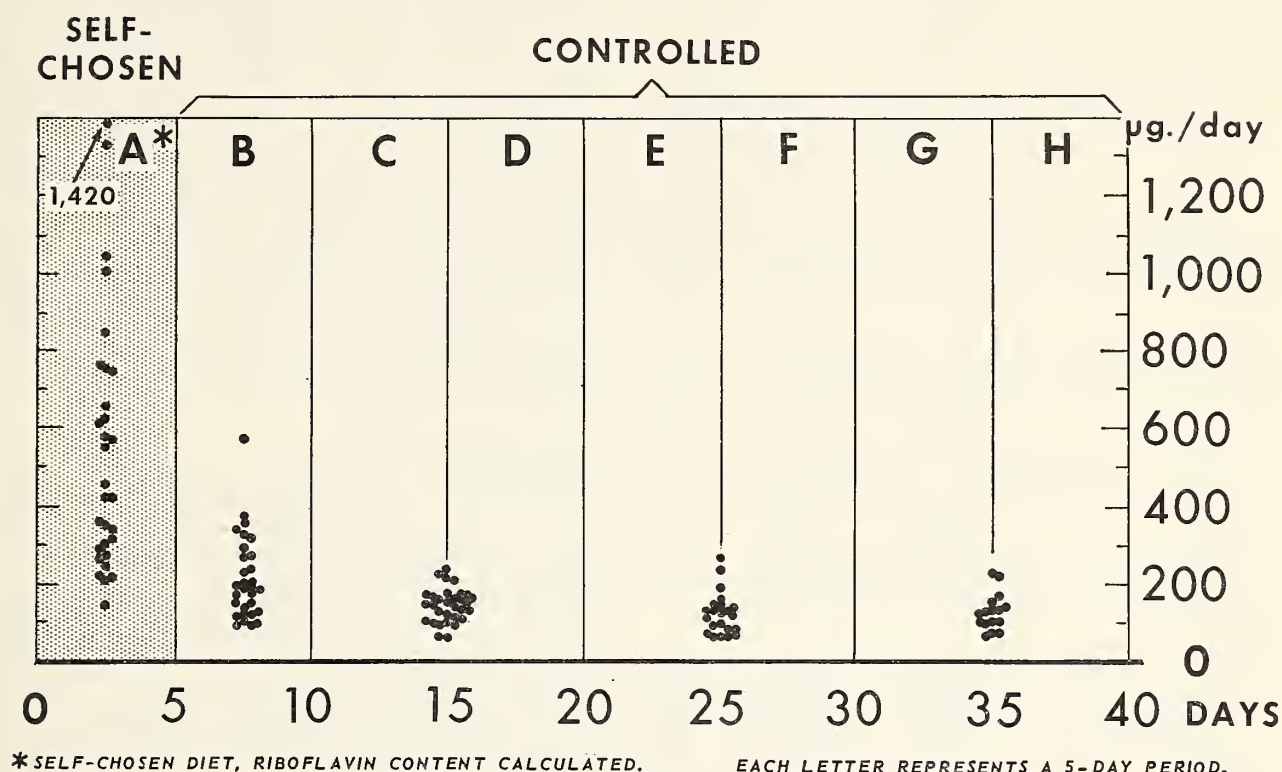
The calculated riboflavin content of the self-chosen diets in Period A ranged from 1,010 to 3,240  $\mu\text{g.}$  daily, with a mean of 1,970  $\mu\text{g.}$  for the 30 subjects. The daily urinary excretion for these subjects ranged from a low of 153  $\mu\text{g.}$  (on an intake of 1,483  $\mu\text{g.}$ ) to a high of 1,420  $\mu\text{g.}$  (on an intake of 2,120  $\mu\text{g.}$ ), and the mean excretion was 545  $\mu\text{g.}$

TABLE 20.—THIAMINE: Daily urinary excretion in terms of total, percentage of intake, and per gram creatinine for each subject in different periods

State and subject code number	Period A			Periods CD			Periods EF			Periods GH		
	Total	Portion of intake	Per gram creatinine	Total	Portion of intake	Per gram creatinine	Total	Portion of intake	Per gram creatinine	Total	Portion of intake	Per gram creatinine
Alabama:	Micro-grams	Percent	Micro-grams	Micro-grams	Percent	Micro-grams	Micro-grams	Percent	Micro-grams	Micro-grams	Percent	Micro-grams
101	169	14.8	142	61	8.2	52						
102	56	5.4	61	39	5.3	42						
103	144	11.9	155	91	12.3	88						
104	105	11.0	76	50	6.7	39						
105	140	14.9	112	67	9.0	58						
106	62	6.0	49	52	7.0	45						
Mean	113	10.7	99	60	8.1	54						
Minnesota:												
201	255	18.8	192	90	10.8	68	92	10.8	70			
202	192	13.1	181	108	13.0	100	107	12.5	96			
203	125	12.2	116	104	12.5	96	108	12.7	99			
204	176	16.6	150	129	15.5	112	140	16.4	119			
205	76	10.3	64	116	13.9	92	149	17.5	112			
206	146	20.5	112	153	18.4	123	176	20.7	136			
207	164	20.2	146	162	19.5	149	170	20.0	152			
Mean	162	16.3	137	123	14.8	106	135	15.8	112			
Nebraska:												
301	242	18.0	216	183	23.2	176	154	21.4	143	140	18.7	133
302	342	26.1	255	213	27.0	205	214	29.8	186	154	20.5	137
303	143	18.3	101	110	13.9	85	100	13.9	72	84	11.2	59
304	191	13.2	160	142	18.0	134	144	20.0	126	107	14.3	91
305	108	7.3	84	62	7.8	52	79	11.0	64	54	7.2	45
306	458	30.7	347	206	26.1	163	190	26.4	145	142	18.9	110
307	245	22.1	163	174	22.0	135	145	20.2	108	136	18.1	99
308	153	23.9	116	190	24.1	165	163	22.7	137	164	21.9	139
Mean	235	19.6	180	160	20.3	139	149	20.7	123	123	16.3	102
Oklahoma:												
401	128	10.5	74	46	5.9	36	54	7.1	42	47	6.1	38
402	222	14.3	146	30	3.8	25	48	6.6	41	30	4.0	25
403	58	3.5	32	31	3.9	24	19	2.5	14	24	3.1	17
404	76	6.1	44	26	3.3	21	31	4.2	27	51	6.7	43
405	132	7.9	96	67	8.5	64	66	8.7	61	69	9.0	67
406	128	9.6	76				37	5.1	30	45	6.0	36
407	156	11.2	103	50	6.4	46	34	4.5	30	50	6.5	43
408	328	18.5	70	103	8.9	58						
409	86	6.2	52		13.1	84	83	11.0	68	79	10.3	66
Mean	146	9.9	90	53	6.7	45	47	6.2	39	49	6.5	42
All subjects	167	14.6	127	101	12.0	87	109	14.2	90	86	11.3	72

# URINARY EXCRETION OF RIBOFLAVIN

## Variability on Controlled Diet for 35 Days



\*SELF-CHOSEN DIET, RIBOFLAVIN CONTENT CALCULATED.

EACH LETTER REPRESENTS A 5-DAY PERIOD.

FIGURE 6.

The shift from self-chosen diets to the standardized diet meant a decreased riboflavin intake for every subject. The standardized diet supplied from 872 to 970 µg. of riboflavin daily in the different States (table 21). On this markedly lower intake the urinary excretion decreased also. For Periods CD the daily excretion ranged from 56 to 242 µg.; for Periods EF from 61 to 267 µg.; and for Periods GH from 66 to 222 µg. (table 22).

Increases in the pantothenic acid intake which were made for the Nebraska subjects following Periods CD did not affect their riboflavin excretion. Similarly, increasing and decreasing the magnesium intake of Minnesota and Oklahoma subjects had no consistent effect on the excretion of riboflavin.

The nutritional status of the body with respect

to riboflavin is sometimes assessed on the basis of the 24-hour urinary excretion of the vitamin. The criteria which have been suggested as indicative of adequate riboflavin nutrition are the same as those mentioned for thiamine—total excretion, percentage of the intake excreted, and excretion per gram of creatinine. The ranges of normal values, however, are not as well established as for thiamine. Horwitt and others (13) have stated that a riboflavin excretion of less than 100 µg. per 24 hours indicates previous dietary inadequacy. Morley and others (23) have judged the intake of their subjects to be adequate because the excretion represented 26 percent of the intake. Aykroyd and others (4) have suggested that an excretion of less than 200 µg. per gram of creatinine is indicative of dietary inadequacy.

TABLE 21.—RIBOFLAVIN: *Mean and standard deviation for daily intake and urinary excretion for subjects in each State and for all subjects during different periods*

State, number of subjects, and period	Intake		Urine	
	Mean	Standard deviation	Mean	Standard deviation
Alabama—6 subjects:	<i>Micrograms</i>	<i>Micrograms</i>	<i>Micrograms</i>	<i>Micrograms</i>
A-----	1,987	341	546	379
B-----	970		208	86
CD-----	970		152	28
Minnesota—7 subjects:				
A-----	1,866	582	453	258
B-----	953		134	40
CD-----	949		97	34
EF-----	969	2	98	32
G-----	976		100	41
Nebraska—8 subjects:				
A-----	2,050	844	756	416
B-----	877		350	73
CD-----	872		189	36
EF-----	891		172	53
GH-----	891		155	42
Oklahoma—9 subjects:				
A-----	1,968	397	428	188
B-----	929		175	66
CD-----	891		138	31
EF—8 subjects-----	893	9	86	25
GH-----	892	3	100	36
All States:				
A—30 subjects-----	1,970	557	545	330
B—30 subjects-----	930	35	219	106
CD—30 subjects-----	915	40	145	45
EF—23 subjects-----	915	36	119	54
GH—16 subjects-----	892	2	128	47

The values for the urinary excretion of riboflavin of each subject expressed in the three ways are given in table 22. During the time they were receiving the standardized diet, which supplied approximately 900  $\mu$ g. of riboflavin daily, the subjects did not consistently meet any of the criteria mentioned. More subjects, however, had a urinary excretion that equaled or exceeded 100  $\mu$ g. of riboflavin daily than met the criteria of an excretion of 26 percent of the intake or an excre-

tion of 200  $\mu$ g. of riboflavin per gram of creatinine. Of the 30 subjects, 5 excreted less than 100  $\mu$ g. in Periods CD, with 10 of the 23 subjects in Periods EF and 4 of the 16 in Periods GH having excretions this low. As much as 26 percent of the riboflavin intake was excreted by only 1 subject in Periods CD and 2 subjects in Periods EF; and only 2 subjects in Periods CD and EF and 1 in GH excreted as much as 200  $\mu$ g. of riboflavin per gram of creatinine. It appears that the 900  $\mu$ g. of riboflavin daily in the standardized diet was not sufficient to maintain the subjects in adequate nutritional status with respect to riboflavin when judged by the usual criteria. This intake is only 60 percent of the 1,500  $\mu$ g. which is the recommended allowance for riboflavin for young women.

The range among the subjects in their urinary excretion of riboflavin on the standardized diet was approximately fivefold as compared with tenfold for their excretion of thiamine.

## Pantothenic Acid

Pantothenic acid intake and excretion were studied for the Nebraska subjects. The values for each subject are presented in table 23. The means and standard deviations for all subjects for each period are given in table 24.

By calculation from the records kept of the self-chosen diets of the subjects during Period A, from 3.4 to 10.3 mg. of pantothenic acid were supplied daily and the mean value was 6.7 mg. Calculation also indicated that 5 of the 8 subjects had diets which provided the nutrients in amounts that approached or exceeded the recommended allowances and these diets supplied approximately 7 mg. of pantothenic acid daily. The mean daily urinary excretion of all 8 subjects was 3.9 mg. of pantothenic acid, with a range of 2.9 to 7.5 mg.

The standardized diet supplied 2.8 mg. of pantothenic acid daily during Periods B, C, and D. During Periods EF, 5 mg. were added in the form of calcium pantothenate for subjects 301, 302, 303, and 304, and 10 mg. for subjects 305, 306, 307, and 308. In Periods GH the two groups of four subjects were switched. Subjects 301 to 304 received an additional 10 mg. of pantothenic acid, and subjects 305 to 308 received an additional 5 mg. of the vitamin. On intakes of 2.8, 7.8, and 12.8 mg. the daily excretion of pantothenic acid in the urine was 3.0, 4.5, and 5.6 mg., respectively. These amounts represented 107, 58, and 44 percent of the respective intakes.

TABLE 22.—RIBOFLAVIN: Daily urinary excretion in terms of total, percentage of intake, and per gram creatinine for each subject in different periods

State and subject code number	Period A			Periods CD			Periods EF			Periods GH		
	Total	Portion of intake	Per gram creatinine	Total	Portion of intake	Per gram creatinine	Total	Portion of intake	Per gram creatinine	Total	Portion of intake	Per gram creatinine
Alabama:	Micro-grams	Percent	Micro-grams	Micro-grams	Percent	Micro-grams	Micro-grams	Percent	Micro-grams	Micro-grams	Percent	Micro-grams
101	1, 016	40.6	854	176	18.1	152	152	---	---	---	---	---
102	221	14.6	240	122	12.6	131	---	---	---	---	---	---
103	365	20.5	392	177	18.2	170	---	---	---	---	---	---
104	1, 045	47.5	752	156	16.1	122	---	---	---	---	---	---
105	361	18.5	289	166	17.1	143	---	---	---	---	---	---
106	269	13.6	213	112	11.5	96	---	---	---	---	---	---
Mean	546	25.9	457	152	15.6	136	---	---	---	---	---	---
Minnesota:	841	29.2	632	56	5.9	42	---	---	---	---	---	---
201	751	36.3	695	91	9.6	84	66	6.8	50	---	---	---
203	209	19.0	194	108	11.4	100	93	9.6	84	---	---	---
204	453	21.0	387	136	14.3	118	142	14.7	129	---	---	---
205	348	23.3	292	61	6.4	40	122	12.5	103	---	---	---
206	153	10.3	118	86	9.1	69	76	7.8	49	---	---	---
207	419	22.3	374	142	15.0	131	61	6.3	47	---	---	---
Mean	453	23.0	384	97	10.2	83	124	12.8	108	---	---	---
Nebraska:	758	33.2	677	242	27.8	233	---	---	---	---	---	---
301	1, 420	67.0	1, 060	164	18.8	158	232	26.0	216	222	24.9	209
303	653	49.8	463	145	16.6	112	143	16.0	124	106	11.9	95
304	609	26.1	512	216	24.8	204	118	13.2	104	131	14.7	94
305	617	30.5	478	163	18.7	137	165	18.5	133	155	17.4	131
306	1, 334	41.2	1, 011	156	17.9	124	179	20.1	137	138	15.5	116
307	414	19.8	276	204	23.4	158	136	15.3	101	140	14.7	102
308	240	23.8	182	224	25.7	195	267	30.0	226	219	15.7	102
Mean	756	36.4	582	189	21.7	163	172	19.2	142	155	24.6	186
Oklahoma:	315	22.0	182	176	19.8	138	---	---	---	---	---	---
401	557	28.1	366	102	11.4	86	70	7.8	55	100	11.2	81
402	308	13.8	172	174	19.5	133	70	7.9	60	66	7.4	55
403	215	14.5	126	105	11.8	86	132	10.2	70	171	19.2	122
404	580	26.0	420	136	15.3	130	66	15.0	114	96	10.7	82
405	266	16.3	157	151	16.9	119	114	7.3	61	68	7.6	67
406	283	12.8	187	135	15.2	123	80	12.9	91	128	14.3	103
407	577	22.1	337	168	18.8	139	---	---	---	---	---	---
408	747	39.3	455	98	10.0	80	66	8.9	71	70	7.9	60
409	---	---	---	---	---	---	---	---	---	---	---	---
Mean	428	21.6	267	138	15.4	115	86	7.3	54	104	11.7	81
All subjects	545	26.7	416	145	15.9	125	119	9.7	72	100	11.2	82
								13.1	99	128	14.3	105

TABLE 23.—PANTOTHENIC ACID: *Mean daily intake and urinary excretion for each subject for each period*

Subject code number and period	Intake	Urine	Subject code number and period	Intake	Urine
	<i>Milligrams</i>	<i>Milligrams</i>		<i>Milligrams</i>	<i>Milligrams</i>
301:			305:		
A.....	7.3	3.5	A.....	7.2	3.2
B.....	2.8	2.7	B.....	2.8	3.2
C.....	2.8	3.3	C.....	2.8	2.8
D.....	2.8	3.2	D.....	2.8	2.4
CD.....	2.8	3.2	CD.....	2.8	2.6
E.....	7.8	4.3	E.....	12.8	5.2
F.....	7.8	4.6	F.....	12.8	5.4
EF.....	7.8	4.4	EF.....	12.8	5.3
G.....	12.8	6.1	G.....	7.8	4.7
H.....	12.8	6.0	H.....	7.8	3.6
GH.....	12.8	6.0	GH.....	7.8	4.2
302:			306:		
A.....	7.1	7.5	A.....	10.3	4.1
B.....	2.8	5.5	B.....	2.8	3.1
C.....	2.8	5.2	C.....	2.8	2.9
D.....	2.8	4.7	D.....	2.8	2.5
CD.....	2.8	5.0	CD.....	2.8	2.7
E.....	7.8	6.1	E.....	12.8	4.6
F.....	7.8	6.6	F.....	12.8	6.3
EF.....	7.8	6.4	EF.....	12.8	5.4
G.....	12.8	7.6	G.....	7.8	4.7
H.....	12.8	6.6	H.....	7.8	4.3
GH.....	12.8	7.1	GH.....	7.8	4.5
303:			307:		
A.....	4.3	3.3	A.....	6.9	3.6
B.....	2.8	3.2	B.....	2.8	3.3
C.....	2.8	3.0	C.....	2.8	2.8
D.....	2.8	2.8	D.....	2.8	2.7
CD.....	2.8	2.9	CD.....	2.8	2.8
E.....	7.8	3.4	E.....	12.8	4.8
F.....	7.8	3.4	F.....	12.8	5.3
EF.....	7.8	3.4	EF.....	12.8	5.0
G.....	12.8	5.0	G.....	7.8	5.5
H.....	12.8	6.2	H.....	7.8	5.0
GH.....	12.8	5.6	GH.....	7.8	5.2
304:			308:		
A.....	7.2	2.9	A.....	3.4	3.4
B.....	2.8	2.4	B.....	2.8	3.2
C.....	2.8	3.4	C.....	2.8	2.9
D.....	2.8	2.1	D.....	2.8	2.7
CD.....	2.8	2.8	CD.....	2.8	2.8
E.....	7.8	3.1	E.....	12.8	5.0
F.....	7.8	3.7	F.....	12.8	5.4
EF.....	7.8	3.4	EF.....	12.8	5.2
G.....	12.8	4.8	G.....	7.8	4.5
H.....	12.8	5.7	H.....	7.8	4.6
GH.....	12.8	5.2	GH.....	7.8	4.6

The differences between the mean pantothenic acid excretion on the three levels of intake are highly significant: Between intakes of 2.8 and 7.8 mg.,  $t=6.25$ ; between 7.8 and 12.8 mg.,  $t=4.01$ ;

and between 2.8 and 12.8 mg.,  $t=26.99$ . The regression of pantothenic acid excretion on intake is shown in figure 7. The correlation coefficient is 0.805.

# INTAKE AND URINARY EXCRETION OF PANTOTHENIC ACID

*Controlled Diet*

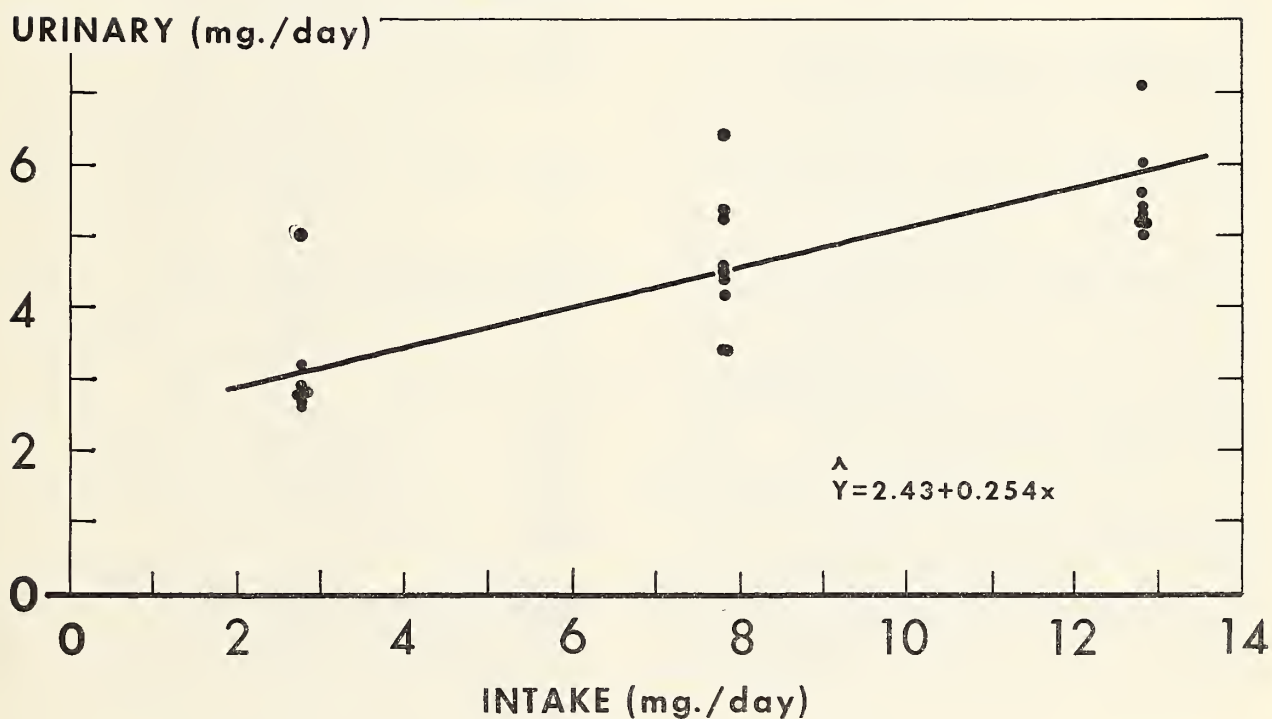


FIGURE 7.

TABLE 24.—PANTOTHENIC ACID: *Mean and standard deviation for all subjects for different periods*

Period	Subject code numbers	Intake	Urine	Standard deviation
		<i>Milligrams</i>	<i>Milligrams</i>	
A-----	301 to 308	6.7	3.9	1.5
B-----	301 to 308	2.8	3.3	.9
CD-----	301 to 308	2.8	3.1	.8
EF-----	301 to 304	7.8	4.4	1.4
EF-----	305 to 308	12.8	5.2	.2
GH-----	301 to 304	12.8	6.0	.8
GH-----	305 to 308	7.8	4.6	.4
EF-----	301 to 308	7.8	4.5	1.4
GH-----				
GH-----	301 to 308	12.8	5.6	.8
EF-----				

## Fat

Data on the intake and fecal excretion of fat of the 30 subjects are summarized in table 25. The ranges in mean daily fat intake and excretion were wide during Period A on the self-chosen diets. The calculated intakes provided from 45.3 to 164.0 gm. of fat daily, with a mean of 107.2 gm. The daily fecal excretion for this period ranged from 1.64 to 8.84 gm. and averaged 4.8 gm.

The standardized diet provided about 90 gm. fat. This was less than 22 of the 30 subjects had been eating in their self-selected diets. Accompanying the lower intake of these 22 subjects in Periods CD, there was a reduced fecal excretion of fat by all but two of them. Subjects 302 and 304 excreted the same amounts on both intakes. Of the 8 subjects whose fat intake was increased when they were transferred to the standardized diet, 7 excreted less fat in the feces than on their self-chosen diets. Fecal fat values were relatively stable for all of the subjects throughout, from Periods CD until the end of the study. The range among individuals for Periods CD was from 1.38 gm. to 3.48 gm. fat. The greatest difference in fat excretion for any subject who was studied beyond

Periods CD occurred with subject 306 who excreted 1.79 gm. fat daily in Periods CD and 3.48 gm. in Periods GH. For most of the subjects, however, the differences were less than 0.5 mg.

TABLE 25.—FAT: *Mean and standard deviation for daily intake and fecal excretion for subjects in each State and for all subjects during different periods*

State, number of subjects, and period	Intake		Feces	
	Mean	Standard deviation	Mean	Standard deviation
	<i>Grams</i>	<i>Grams</i>	<i>Grams</i>	<i>Grams</i>
Alabama—6 subjects:				
A-----	108.3	12.3	5.3	0.7
B-----	86.4		2.4	.1
CD-----	86.4		2.4	.3
Minnesota—7 subjects:				
A-----	91.5	15.8	3.9	1.5
B-----	91.0		3.0	.8
CD-----	89.7		2.1	.6
EF-----	89.9		2.2	.4
G-----	86.2		2.5	.5
Nebraska—8 subjects:				
A-----	101.4	29.0	3.7	1.8
B-----	82.9		2.8	1.0
CD-----	92.3		2.2	.2
EF-----	90.9		2.1	.4
GH-----	91.7		2.4	.5
Oklahoma—9 subjects:				
A-----	124.0	24.8	6.2	1.5
B-----	88.2		3.2	1.4
CD-----	87.9		2.6	.4
EF—8 subjects-----	87.1	.3	2.7	.5
GH-----	87.7	1.1	2.5	.2
All States:				
A—30 subjects-----	107.2	24.7	4.8	1.8
B—30 subjects-----	87.0	3.0	2.9	1.0
CD—30 subjects-----	89.2	2.2	2.3	.5
EF—23 subjects-----	89.3	1.7	2.3	.5
GH—16 subjects-----	89.7	2.3	2.4	.4

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APPENDIX TABLE 26.—Data for individual subjects

State, subject code number, and period	Energy value	Nitrogen				Creatinine	Fat		Thiamine		Riboflavin	
		Intake	Urine	Feces	Balance		Intake	Feces	Intake	Urine	Intake	Urine
ALABAMA:												
101:	Cal.	Grams	Grams	Grams	Grams	Grams						
A-----	2,572	14.6	9.38	1.22	4.00	1.19						
B-----	2,178	10.65	8.61	.95	1.09	1.14						
C-----	2,178	10.66	9.04	1.03	.59	1.17						
D-----	2,178	10.65	8.94	1.02	.69	1.16						
CD-----	2,178	10.66	8.99	1.02	.64	1.16						
102:												
A-----	2,110	12.0	7.10	1.34	3.56	.92						
B-----	2,178	10.60	7.44	1.19	1.97	.88						
C-----	2,133	10.59	7.49	1.26	1.84	.92						
D-----	2,102	10.59	8.09	1.10	1.40	.94						
CD-----	2,117	10.59	7.79	1.18	1.62	.93						
103:												
A-----	2,370	13.5	6.55	1.27	5.68	.93						
B-----	2,178	10.67	8.18	1.06	1.43	1.13						
C-----	2,178	10.64	7.21	1.18	2.25	1.02						
D-----	2,178	10.64	8.74	.82	1.08	1.05						
CD-----	2,178	10.64	7.98	1.00	1.66	1.04						
104:												
A-----	2,266	12.1	10.22	1.13	.75	1.39						
B-----	2,081	10.71	11.21	.87	1.37	1.36						
C-----	2,208	10.66	9.09	.97	.60	1.30						
D-----	2,178	10.68	8.95	.99	.74	1.25						
CD-----	2,193	10.67	9.02	.98	.67	1.28						
105:												
A-----	2,066	12.4	8.78	1.12	2.50	1.25						
B-----	2,081	10.69	8.58	.84	1.28	1.17						
C-----	2,081	10.66	8.70	.85	1.11	1.17						
D-----	2,081	10.66	9.73	.77	.16	1.15						
CD-----	2,081	10.66	9.22	.81	.64	1.16						
106:												
A-----	2,233	12.6	9.01	1.38	2.21	1.26						
B-----	2,178	10.59	9.03	.63	.93	1.17						
C-----	2,178	10.60	9.02	.75	.83	1.17						
D-----	2,178	10.60	8.72	.78	1.10	1.16						
CD-----	2,178	10.60	8.87	.76	.96	1.16						

## MINNESOTA:

201:

A	2,730	14.80	11.05	1.22	2.53	1.33	120.8	3.92	1,354	255	2,880	841
B	2,176	10.91	9.42	1.21	.28	1.25	91.04	2.69	832	125	953	119
C	2,190	11.95	9.06	.97	1.92	1.30	90.34	2.11	829	93	926	60
D	2,199	12.36	9.36	.30	2.70	1.36	89.03	.65	834	87	972	52
CD	2,194	12.16	9.21	.64	2.31	1.33	89.68	1.38	831	90	949	56
E	2,255	11.14	9.22	.97	.95	1.30	89.94	2.56	849	87	985	65
F	2,177	11.06	9.59	1.14	.33	1.34	89.89	2.56	856	97	952	67
EF	2,216	11.10	9.40	1.06	.64	1.32	89.92	2.56	852	89	968	66
G	2,171	11.11	9.68	.91	.52	1.32	86.22	2.11	839	85	976	56
EFG	2,201	11.10	9.50	1.00	.60	1.32	88.68	2.41	848	90	971	62
202:												
A	2,400	12.00	8.58	1.23	2.19	1.08	99.6	4.76	1,247	192	2,071	751
B	2,166	10.97	8.75	1.12	1.10	1.06	91.04	2.78	832	164	953	152
C	2,184	12.00	9.08	.89	2.03	1.07	90.34	2.44	829	107	926	97
D	2,210	12.44	9.12	1.12	2.20	1.09	89.03	3.15	834	109	972	85
CD	2,197	12.22	9.10	1.00	2.12	1.08	89.68	2.80	831	108	949	91
E	2,220	11.18	8.37	1.13	1.68	1.14	89.94	2.86	849	98	985	99
F	2,199	11.12	9.54	.98	.60	1.08	89.89	2.55	856	116	952	87
EF	2,209	11.15	8.95	1.06	1.14	1.11	89.92	2.70	852	107	968	93
G	2,228	11.17	9.51	1.21	.45	1.13	86.22	3.11	839	103	976	126
EFG	2,215	11.16	9.14	1.11	.91	1.12	88.68	2.84	848	106	971	104
203:												
A	2,312	11.62	7.32	1.22	3.08	1.08	83.2	4.54	1,024	125	1,098	209
B	2,244	10.81	9.04	1.11	.66	1.02	91.04	3.34	832	115	953	117
C	2,230	11.81	9.08	.82	1.91	1.03	90.34	1.61	829	104	926	122
D	2,267	12.24	9.57	.54	2.13	1.13	89.03	1.60	834	104	972	94
CD	2,248	12.02	9.32	.68	2.02	1.08	89.68	1.60	831	104	949	108
E	2,309	10.99	9.22	.78	.99	1.10	89.94	2.43	849	110	985	140
F	2,286	10.90	9.17	.35	1.38	1.09	89.89	1.17	856	106	952	143
EF	2,297	10.94	9.20	.56	1.18	1.09	89.92	1.80	852	108	968	141
G	2,179	10.95	9.37	.61	.97	1.14	86.22	2.22	839	104	976	152
EFG	2,258	10.94	9.25	.58	1.11	1.11	88.68	1.94	848	106	971	145
204:												
A	2,334	12.42	9.04	.84	2.54	1.17	97.3	3.91	1,060	176	2,162	453
B	2,154	10.93	9.39	1.26	.28	1.12	91.04	2.67	832	162	953	171
C	2,130	11.86	9.43	.91	1.52	1.16	90.34	2.04	829	133	926	154
D	2,152	12.30	8.73	1.16	2.41	1.14	89.03	2.46	834	125	972	117
CD	2,141	12.08	9.08	1.04	1.96	1.15	89.68	2.25	831	129	949	135
E	2,146	11.05	9.70	.83	.52	1.18	89.94	1.76	849	133	985	116
F	2,187	11.29	10.06	1.08	.15	1.17	89.89	2.56	855	146	963	127
EF	2,166	11.17	9.87	.96	.34	1.17	89.92	2.16	852	139	974	127
G	2,131	11.01	8.64	.96	1.41	1.22	86.22	2.21	839	101	976	125
EFG	2,155	11.12	9.47	.96	.69	1.19	88.68	2.18	847	127	975	123

APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Energy value	Nitrogen				Creatinine		Fat		Thiamine		Riboflavin	
		Intake	Urine	Feces	Balance			Intake	Feces	Intake	Urine	Intake	Urine
MINNESOTA—Continued													
205:	Cal.	Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams	µg.	µg.	µg.	µg.
A-----	1,793	8.98	6.34	0.60	2.04	1.19	72.9	2.31	737	1,492	76	1,492	348
B-----	2,163	10.72	8.84	.93	.95	1.24	91.04	1.90	832	953	148	953	94
C-----	2,187	11.75	8.98	.87	1.90	1.25	90.34	1.52	829	926	125	926	55
D-----	2,218	12.20	8.81	.76	2.63	1.27	89.03	1.82	834	106	106	972	67
CD-----	2,202	11.98	8.90	.82	2.26	1.26	89.68	1.67	831	949	115	949	61
E-----	2,244	10.95	9.23	.75	.97	1.33	89.94	1.60	849	985	151	985	73
F-----	2,243	10.87	8.86	.94	1.07	1.34	89.89	2.11	856	952	147	952	80
EF-----	2,243	10.91	9.05	.84	1.02	1.33	89.92	1.86	852	968	149	968	76
G-----	2,205	10.92	9.22	1.01	.69	1.36	86.22	2.07	839	976	128	976	50
EFG-----	2,230	10.91	9.10	.90	.91	1.34	88.68	1.93	848	971	142	971	68
206:													
A-----	1,890	9.18	7.77	.76	.65	1.30	84.5	5.92	713	1,483	146	1,483	153
B-----	2,160	10.73	8.94	.86	.93	1.26	91.04	2.68	832	953	154	953	90
C-----	2,182	11.76	9.93	.63	1.20	1.26	90.34	2.78	829	926	152	926	77
D-----	2,199	12.21	9.37	.57	2.27	1.22	89.03	3.02	834	972	154	972	94
CD-----	2,190	11.98	9.65	.60	1.74	1.24	89.68	2.90	831	949	153	949	85
E-----	2,204	10.96	9.62	.67	.67	1.28	89.94	2.31	849	985	170	985	56
F-----	2,220	10.88	9.73	.57	.58	1.30	89.89	2.49	856	952	181	952	66
EF-----	2,212	10.92	9.68	.62	.62	1.29	89.92	2.40	852	968	175	968	61
G-----	2,234	10.93	9.26	.70	.97	1.27	86.22	3.45	839	976	155	976	66
EFG-----	2,219	10.92	9.53	.65	.74	1.28	88.68	2.75	848	971	169	971	63
207:													
A-----	1,980	10.70	8.41	.42	1.87	1.12	82.2	1.64	812	1,879	164	1,879	419
B-----	2,243	10.95	9.40	1.13	.42	1.12	91.04	4.59	832	953	157	953	198
C-----	2,178	11.91	8.81	.82	2.28	1.08	90.34	2.09	829	926	148	926	131
D-----	2,148	12.38	8.73	.74	2.91	1.09	89.03	1.66	834	972	175	972	154
CD-----	2,163	12.14	8.77	.78	2.60	1.08	89.68	1.88	831	949	161	949	142
E-----	2,185	11.14	8.75	.70	1.69	1.10	89.94	1.94	849	985	168	985	132
F-----	2,165	11.05	9.74	.44	.87	1.20	89.89	1.30	856	952	173	952	117
EF-----	2,175	11.10	9.25	.57	1.28	1.15	89.92	1.62	852	968	170	968	124
G-----	2,164	11.10	9.38	.83	.89	1.18	86.22	2.39	839	976	164	976	124
EFG-----	2,171	11.10	9.29	.66	1.15	1.16	88.68	1.88	848	971	168	971	124
NEBRASKA:													
301:													
A-----	2,581	14.81	9.71	.83	4.27	1.12	122.3	3.25	1,340	2,280	242	2,280	758
B-----	2,081	10.96	9.68	.57	.71	1.06	82.89	2.08	774	877	194	877	513

C	2,081	11.10	9.51	.42	1.17	1.02	93.03	1.65	785	175	852	221
D	2,081	11.00	9.78	.71	.51	1.06	91.55	2.63	794	191	891	263
CD	2,081	11.05	9.64	.56	.84	1.04	92.29	2.14	789	183	871	242
E	2,081	11.00	9.15	.61	1.24	1.10	91.66	2.04	721	165	866	237
F	2,081	10.93	9.66	.32	.95	1.06	90.13	1.27	717	144	916	227
EF	2,081	10.96	9.40	.46	1.10	1.08	90.90	1.66	719	154	891	232
G	2,081	10.99	9.62	.40	.97	1.05	91.91	1.39	757	143	896	247
H	2,081	10.98	9.13	.67	1.18	1.05	91.58	2.33	742	137	886	198
GH	2,081	10.98	9.36	.54	1.08	1.05	91.74	1.86	749	140	891	222
302:												
A	2,408	15.42	12.14	0.54	2.74	1.34	124.4	2.32	1,310	342	2,120	1,420
B	2,081	10.97	8.96	.89	1.12	1.13	82.89	3.51	774	255	877	323
C	2,081	11.08	9.18	.81	1.09	1.04	93.03	2.55	785	216	852	151
D	2,081	11.00	8.98	.64	1.38	1.04	91.55	2.27	794	210	891	177
CD	2,081	11.04	9.08	.72	1.24	1.04	92.29	2.41	789	213	871	164
E	2,081	10.98	9.92	.73	.33	1.16	91.66	3.01	721	211	866	159
F	2,081	10.93	9.16	.70	1.07	1.14	90.13	2.31	717	216	891	127
EF	2,081	10.96	9.54	.72	.70	1.15	90.90	2.66	719	213	891	143
G	2,081	10.97	9.51	.87	.59	1.12	91.91	2.85	757	156	896	98
H	2,081	10.98	8.91	.81	1.26	1.12	91.58	2.42	742	153	886	115
GH	2,081	10.98	9.22	.84	.92	1.12	91.74	2.64	749	154	891	106
303:												
A	1,797	12.38	10.53	.84	1.01	1.40	83.7	3.31	780	143	1,310	653
B	2,081	11.09	10.93	.72	— .56	1.38	82.89	1.75	774	126	877	333
C	2,081	11.20	10.17	.55	.48	1.30	93.03	1.61	785	126	852	154
D	2,081	11.14	10.01	.88	.25	1.29	91.55	2.46	794	95	891	136
CD	2,081	11.17	10.09	.72	.36	1.30	92.29	2.04	789	110	871	145
E	2,091	11.12	9.48	.56	1.08	1.38	91.66	1.48	721	91	866	144
F	2,131	11.05	10.14	.64	.27	1.39	90.13	2.05	717	108	916	119
EF	2,111	11.08	9.81	.60	.68	1.39	90.90	1.76	719	99	891	131
G	2,131	11.10	9.64	.67	.79	1.41	91.91	1.83	757	89	896	109
H	2,131	11.13	9.34	.94	.85	1.40	91.58	2.49	742	79	886	153
GH	2,131	11.12	9.49	.80	.82	1.41	91.74	2.16	749	84	891	131
304:												
A	2,257	14.13	9.16	.78	4.19	1.19	108.1	2.35	1,450	191	2,330	609
B	2,081	10.96	9.38	1.29	.29	1.12	82.89	3.04	774	140	877	362
C	2,081	11.08	9.21	1.06	.81	1.06	93.03	2.07	785	150	852	271
D	2,081	11.00	8.86	1.25	.89	1.07	91.55	2.63	794	135	891	162
CD	2,081	11.04	9.04	1.16	.85	1.06	92.29	2.35	789	142	871	216
E	2,081	10.98	8.90	.89	1.19	1.14	91.66	1.75	721	133	866	150
F	2,081	10.93	9.07	1.14	.72	1.14	90.13	2.59	717	156	916	87
EF	2,081	10.96	8.98	1.02	.96	1.14	90.90	2.17	719	144	891	118
G	2,081	10.99	9.31	1.04	.64	1.16	91.91	2.29	757	119	896	139
H	2,081	11.02	9.23	1.10	.69	1.19	91.58	2.81	742	95	886	171
GH	2,081	11.00	9.27	1.07	.66	1.17	91.74	2.55	749	107	891	155

APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Energy value	Nitrogen				Creatinine		Fat		Thiamine		Riboflavin	
		Intake	Urine	Feces	Balance	Grams		Intake	Feces	Intake	Urine	Intake	Urine
NEBRASKA—Continued 305:	Cal.												
	2,648	13.87	9.23	1.31	3.33	Grams	Grams	Grams	Grams	μg.	μg.	μg.	μg.
	2,081	10.95	9.38	.69	.88			128.1	4.43	1,480	108	2,020	617
								82.89	2.19	774	78	877	275
	2,081	11.08	9.02	.42	1.64			93.03	1.37	785	75	852	133
	2,091	10.90	10.63	1.01	-.74			91.55	3.41	794	49	891	193
	2,086	10.99	9.82	.72	.45			92.29	2.39	789	62	871	163
	2,131	10.98	9.90	.73	.35			91.66	2.39	721	75	866	183
	2,161	10.92	8.80	.72	1.40			90.13	1.69	717	83	916	147
	2,146	10.95	9.35	.72	.88			90.90	2.04	719	79	891	165
306:	2,241	11.00	9.07	.61	1.32			91.91	1.57	757	54	896	150
	2,281	11.03	8.66	1.26	1.11			91.58	3.51	742	53	886	125
	2,261	11.02	8.86	.94	1.22			91.74	2.56	749	53	891	137
	1,976	14.55	10.90	1.09	2.56			81.0	2.93	1,490	458	3,240	1,334
	2,081	11.07	10.01	1.41	-.35			82.89	3.71	774	310	877	328
	2,081	11.18	9.29	.77	1.12			93.03	1.91	785	201	852	161
	2,081	11.02	9.16	.55	1.31			91.55	1.67	794	210	891	150
	2,081	11.10	9.22	.66	1.22			92.29	1.79	789	205	871	155
	2,081	11.12	9.79	.59	.74			91.66	1.99	721	176	866	190
307:	2,081	11.03	9.93	.39	.71			90.13	1.37	717	203	916	168
	2,081	11.08	9.86	.49	.72			90.90	1.68	719	189	891	179
	2,081	11.14	9.69	.61	.84			91.91	2.29	757	144	896	151
	2,081	11.15	9.47	1.23	.45			91.58	4.62	742	139	886	111
	2,081	11.14	9.58	.92	.64			91.74	3.46	749	141	891	131
	2,098	13.57	12.22	1.35	.00			118.1	7.88	1,100	245	2,090	414
	2,081	11.07	11.02	1.46	-1.41			82.89	4.43	774	203	877	295
	2,081	11.19	9.80	.87	.52			93.03	2.01	785	175	852	265
	2,081	11.02	9.50	1.07	.45			91.55	2.59	794	173	891	142
308:	2,081	11.10	9.65	.97	.48			92.29	2.30	789	174	871	203
	2,091	11.10	9.15	1.27	.68			91.66	2.56	721	129	866	148
	2,131	11.05	9.20	1.32	.53			90.13	2.69	717	161	916	123
	2,111	11.08	9.18	1.30	.60			90.90	2.62	719	145	891	135
	2,131	11.09	9.60	.95	.54			91.91	2.59	757	129	896	179
	2,131	11.12	9.22	.83	1.07			91.58	1.71	742	144	886	101
	2,131	11.10	9.41	.89	.80			91.74	2.15	750	136	891	140

308:

A	1,241	6.12	8.65	0.99	-3.52	1.32	45.3	3.09	640	153	1,010	240
B	2,081	10.95	9.67	.59	.69	1.25	82.89	1.51	774	186	877	371
C	2,081	11.08	9.38	1.12	.58	1.15	93.03	2.55	785	193	852	205
D	2,081	10.90	9.43	.79	.68	1.15	91.55	2.05	794	187	891	243
CD	2,081	10.99	9.40	.96	.63	1.15	92.29	2.30	789	190	871	224
E	2,081	10.98	9.74	.62	.62	1.21	91.66	1.60	721	157	866	287
F	2,081	10.93	10.00	1.14	-.21	1.16	90.13	2.99	717	169	916	247
EF	2,081	10.96	9.87	.88	.20	1.19	90.90	2.30	719	163	891	267
G	2,081	10.99	9.26	.90	.83	1.15	91.91	2.15	757	162	896	213
H	2,081	11.02	9.46	1.00	.56	1.20	91.58	2.18	742	165	886	225
GH	2,081	11.00	9.36	.95	.70	1.18	91.74	2.16	749	163	891	219
OKLAHOMA:												
401:												
A	1,922	10.9	8.48	1.32	1.10	1.73	85.00	5.14	1,220	128	1,430	315
B	2,213	11.01	6.90	.91	3.20	1.58	88.18	4.44	775	46	929	201
C	2,543	11.03	7.74	1.14	2.15	1.27	87.32	3.00	778	36	900	236
D	2,311	11.28	8.72	1.04	1.52	1.28	88.57	2.97	793	56	882	116
CD	2,427	11.16	8.23	1.09	1.84	1.28	87.94	2.98	785	46	891	176
E	2,394	10.34	8.34	1.02	.98	1.31	85.98	2.26	753	66	867	86
F	2,311	10.24	8.38	.92	.94	1.24	87.72	1.85	760	42	932	55
EF	2,352	10.29	8.36	.97	.96	1.27	86.85	2.06	756	54	899	70
G	2,416	10.76	8.70	1.18	.88	1.25	88.74	1.86	779	52	825	113
H	2,774	10.30	8.00	1.30	1.00	1.22	88.40	2.95	749	42	956	88
GH	2,595	10.53	8.35	1.24	.94	1.23	88.57	2.40	764	47	890	100
402:												
A	2,451	13.4	8.56	2.01	2.83	1.52	108.00	8.84	1,550	222	1,980	557
B	2,190	11.02	6.78	.64	3.60	1.47	88.18	2.08	775	128	929	118
C	2,561	11.04	7.48	1.11	2.45	1.21	87.32	3.99	778	24	900	127
D	2,307	11.28	8.44	1.05	1.79	1.16	88.57	2.97	793	36	882	77
CD	2,434	11.16	7.96	1.08	2.12	1.18	87.94	3.48	785	30	891	102
E	2,455	10.37	8.56	1.13	.68	1.18	86.18	3.19	720	52	858	77
F	2,434	10.85	9.48	1.23	.14	1.13	88.75	3.43	742	44	905	64
EF	2,444	10.61	9.02	1.18	.41	1.15	87.46	3.31	731	48	881	70
G	2,544	10.46	7.94	1.06	1.46	1.20	86.31	2.76	761	28	833	58
H	2,657	10.48	8.24	.93	1.31	1.20	86.09	2.40	749	32	960	73
GH	2,600	10.47	8.09	1.00	1.38	1.20	86.20	2.58	755	30	896	65

OKLAHOMA:

401:

402:

APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Energy value	Nitrogen				Creatinine		Fat		Thiamine		Riboflavin	
		Intake	Urine	Feces	Balance			Intake	Feces	Intake	Urine	Intake	Urine
OKLAHOMA—Continued 403:	Cal.	Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams	μg.	μg.	μg.	μg.
	3,457	18.9	9.00	1.76	8.14	1.79	164.00	6.43	58	1,670	58	2,240	308
	2,159	11.01	7.41	.94	2.66	1.74	88.18	3.44	168	1,775	168	929	320
	2,489	11.04	7.42	1.20	2.42	1.30	87.32	2.26	34	778	34	900	157
	2,210	11.28	8.78	.68	1.82	1.32	88.57	1.80	28	793	28	882	190
	2,349	11.16	8.10	.94	2.12	1.31	87.94	2.03	31	785	31	891	173
	2,292	10.35	8.30	1.14	.91	1.33	85.98	2.87	16	753	16	867	115
	2,281	10.25	7.94	1.01	1.30	1.31	87.72	1.45	22	760	22	932	70
	2,286	10.30	8.12	1.08	1.10	1.32	86.85	2.16	19	756	19	899	92
	2,383	10.77	8.54	.91	1.32	1.47	88.74	2.23	22	779	22	825	133
	2,622	10.31	9.05	1.05	.21	1.33	88.40	2.31	26	749	26	956	209
	2,502	10.54	8.80	.98	.76	1.40	88.57	2.27	24	764	24	890	171
404:	2,234	11.7	9.30	1.26	1.14	1.71	97.00	6.43	76	1,240	76	1,480	215
	2,112	11.01	6.88	.43	3.70	1.49	88.18	2.52	174	1,775	174	929	99
	2,350	11.03	7.72	.32	2.99	1.24	87.32	1.25	24	778	24	900	102
	2,152	11.28	8.06	1.17	2.05	1.20	88.57	3.74	28	793	28	882	108
	2,251	11.16	7.89	.74	2.52	1.22	87.94	2.50	26	785	26	891	105
	2,276	10.37	8.90	.99	.48	1.19	86.18	3.39	30	720	30	858	178
	2,225	10.84	8.74	.55	1.55	1.13	88.75	1.84	32	742	32	905	87
	2,250	10.61	8.82	.77	1.02	1.16	87.46	2.62	31	731	31	881	132
	2,343	10.45	9.02	1.05	.38	1.19	86.31	3.38	68	761	68	833	123
	2,408	10.47	7.82	.76	1.89	1.15	86.09	2.22	34	749	34	960	68
	2,375	10.46	8.42	.90	1.14	1.17	86.20	2.80	51	755	51	896	95
	2,800	15.5	9.80	1.06	4.64	1.38	130.00	3.53	132	1,670	132	2,230	580
	2,120	11.01	6.70	1.25	3.06	1.21	88.18	5.37	174	1,775	174	929	206
405:	2,175	11.03	7.18	1.00	2.85	1.05	87.32	3.57	70	778	70	900	177
	2,011	11.27	7.94	1.23	2.10	1.05	88.57	2.25	64	793	64	882	96
	2,093	11.15	7.56	1.12	2.48	1.05	87.94	2.91	67	785	67	891	136
	2,033	10.34	8.74	1.09	.51	1.08	85.98	2.99	70	753	70	867	40
	2,016	10.24	8.88	1.09	.27	1.08	87.72	2.56	62	760	62	932	93
	2,024	10.29	8.81	1.09	.39	1.08	86.85	2.78	66	756	66	899	66
	2,011	10.76	8.54	.95	1.27	1.04	88.74	2.43	76	779	76	825	58
	2,032	10.30	8.30	1.25	.75	1.01	88.40	2.17	62	749	62	956	79
	2,021	10.53	8.42	1.10	1.02	1.02	88.57	2.30	69	764	69	890	68



APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Calcium				Phosphorus				Magnesium			
	Intake	Urine	Feces	Balance	Intake	Urine	Feces	Balance	Intake	Urine	Feces	Balance
ALABAMA:												
101:												
A-----	Mg. 1,372	Mg. 289	Mg. 1,000	Mg. 83	Mg. 1,671	Mg. 857	Mg. 485	Mg. 329	Mg. 322	Mg. 103	Mg. 123	Mg. 96
B-----	703	189	504	10	938	531	325	82	252	79	138	35
C-----	703	186	578	-61	938	528	433	-23	252	91	182	-21
D-----	703	190	495	18	938	516	362	30	252	92	165	-5
CD-----	703	188	536	-22	938	537	398	4	252	92	173	-13
102:												
A-----	765	111	610	44	1,140	501	458	181	205	60	139	6
B-----	703	62	528	113	938	396	419	123	252	56	172	24
C-----	703	58	607	38	937	390	506	41	251	74	187	-10
D-----	702	86	509	107	937	398	101	138	251	78	163	10
CD-----	702	72	558	72	937	394	454	90	251	76	175	0
103:												
A-----	893	182	897	-186	1,312	577	538	197	265	107	138	20
B-----	703	156	548	-1	938	427	466	45	252	120	130	2
C-----	703	133	573	-3	938	441	454	43	252	117	123	12
D-----	703	163	440	100	938	503	380	55	252	148	97	7
CD-----	703	148	506	48	938	472	417	49	252	132	110	10
104:												
A-----	882	143	865	-126	1,189	833	540	-184	210	86	130	-6
B-----	703	127	589	-13	938	613	430	-105	252	104	152	-4
C-----	704	133	666	-95	938	579	526	-167	252	105	194	-47
D-----	703	143	533	27	938	571	390	-23	252	107	155	-10
CD-----	704	138	600	-34	938	575	458	-95	252	106	174	-28
105:												
A-----	773	282	588	-97	1,170	738	373	59	209	108	112	-11
B-----	703	224	482	-3	938	525	352	61	252	125	135	-8
C-----	703	240	474	-11	938	631	323	-16	252	126	145	-19
D-----	703	216	472	15	938	640	322	-24	252	131	131	-10
CD-----	703	228	473	2	938	636	322	-20	252	128	138	-14
106:												
A-----	1,064	157	618	259	1,450	683	461	306	251	104	139	8
B-----	703	110	523	70	938	483	338	117	252	87	118	47
C-----	703	108	688	-93	938	491	466	-19	252	99	188	-35
D-----	703	129	601	-27	938	524	432	-18	252	104	159	-11
CD-----	703	118	614	-60	938	508	449	-18	252	102	174	-23

## MINNESOTA:

201:

A	1, 338	186	1, 062	90	1, 844	953	613	278	354	123	219	12
B	722	153	906	-337	991	561	570	-140	292	119	202	-29
C	731	156	700	-125	1, 023	491	535	-3	319	124	210	-15
D	753	162	274	317	1, 053	543	199	311	322	121	88	113
CD	742	159	487	96	1, 038	517	367	154	320	122	149	49
E	744	162	866	-284	976	567	642	-233	239	120	238	-119
F	728	157	786	-215	976	643	539	-206	236	131	188	-83
EF	736	160	826	-250	976	605	591	-220	238	126	213	-101
G	718	178	630	-90	982	627	445	-90	233	131	159	-57
CFG	730	166	760	-196	978	612	542	-176	236	127	195	-86
202:												
A	969	31	897	41	1, 431	680	607	144	301	98	216	-13
B	722	50	704	-32	991	568	391	32	292	130	176	-14
C	731	54	582	95	1, 023	538	301	184	319	134	166	19
D	753	42	738	-27	1, 053	622	401	30	322	130	193	-1
CD	742	48	660	34	1, 038	580	351	107	320	132	179	9
E	744	53	716	-25	976	533	435	8	239	108	158	-27
F	728	45	654	29	976	604	389	-17	236	122	137	-23
EF	736	49	685	2	976	568	412	-4	238	115	148	-25
G	718	44	789	-115	982	634	468	-120	233	134	176	-77
CFG	730	47	720	-37	978	590	431	-43	236	121	157	-42
203:												
A	559	227	407	-75	1, 025	596	352	77	231	113	189	-71
B	722	149	545	28	991	557	460	-26	292	106	220	-34
C	731	201	399	131	1, 023	480	309	234	319	114	136	69
D	753	187	437	129	1, 053	495	362	196	322	122	133	67
CD	742	194	418	130	1, 038	488	336	215	320	118	134	68
E	744	160	688	-104	976	483	540	-47	239	103	194	-58
F	728	174	360	194	976	546	272	158	236	114	79	43
EF	736	167	524	45	976	514	406	56	238	109	137	-8
G	718	189	582	-53	982	568	440	-26	233	114	146	-27
CFG	730	174	543	13	978	532	417	28	236	110	140	-14
204:												
A	1, 347	96	994	257	1, 533	775	532	226	260	83	164	13
B	722	78	745	-101	991	629	422	-60	292	92	229	-29
C	731	94	590	47	1, 023	616	295	112	319	117	195	7
D	753	87	778	-112	1, 053	529	453	71	322	111	215	-4
CD	742	90	684	-32	1, 038	572	374	92	320	114	204	2
E	744	103	574	67	976	566	340	70	239	88	148	3
F	726	90	717	-81	974	566	431	-23	237	98	179	-40
EF	735	96	646	-7	975	565	386	24	238	93	163	-18
G	718	86	690	-58	982	548	400	34	233	93	162	-22
CFG	729	93	660	-24	977	560	390	27	236	93	163	-20



C	725	240	483	2	938	430	405	103	277	99	131	47
D	732	241	770	-279	946	501	678	-233	271	110	213	-52
CD	728	240	626	-138	942	466	542	-65	274	104	172	-2
E	724	238	576	-90	957	510	517	-70	283	109	163	11
F	728	216	326	186	952	537	278	137	267	105	94	68
EF	726	227	451	48	954	524	398	34	275	107	128	40
G	743	208	442	93	946	492	381	73	287	105	119	63
H	716	245	656	-186	944	484	547	-87	284	105	190	-11
GH	729	226	549	-46	945	488	464	-7	286	105	155	26
302:												
A	1, 108	176	762	170	1, 421	795	476	150	306	103	113	90
B	718	128	979	-389	959	576	623	-240	260	96	196	-32
C	725	121	673	-69	938	603	424	-89	277	109	176	-8
D	732	136	505	91	946	544	319	83	271	92	139	40
CD	728	128	589	11	942	574	372	-3	274	100	158	16
E	724	111	719	-106	957	567	490	-100	283	107	191	-15
F	728	126	645	-43	952	585	364	3	267	100	164	3
EF	726	118	682	-74	954	576	427	-48	275	104	177	-6
G	743	130	784	-171	946	542	528	-124	287	108	202	-23
H	715	134	528	53	944	460	374	110	284	94	139	51
GH	729	132	656	-59	945	501	451	-7	286	101	171	14
303:												
A	495	159	564	-228	1, 050	646	498	-94	207	74	153	-20
B	718	135	467	116	959	563	391	5	260	90	128	42
C	725	152	536	37	938	550	452	-64	277	106	148	23
D	732	182	805	-255	946	532	675	-261	271	105	221	-55
CD	728	167	670	-109	942	541	564	-162	274	106	184	-16
E	724	197	462	65	957	548	377	32	283	116	127	40
F	729	206	558	-35	953	552	426	-25	267	119	159	-11
EF	726	202	510	15	955	550	402	4	275	118	143	14
G	744	188	657	-101	947	489	562	-104	287	114	185	-12
H	716	197	763	-244	945	505	643	-203	284	103	227	-46
GH	730	192	710	-172	946	497	602	-154	286	108	207	-29
304:												
A	975	138	442	395	1, 441	700	260	481	285	69	87	129
B	718	101	399	218	959	666	359	-66	260	75	137	48
C	725	120	512	93	938	592	309	37	277	79	150	48
D	732	112	695	-75	946	609	411	74	271	80	199	-8
CD	728	116	604	9	942	600	360	-18	274	80	174	20
E	724	106	493	125	957	612	260	85	283	84	146	53
F	728	108	704	-84	952	589	402	-39	267	88	201	-22
EF	726	107	598	20	954	600	331	23	275	86	173	16
G	743	109	601	33	946	491	359	96	287	81	167	39
H	715	98	648	-31	944	593	384	-33	284	84	189	11
GH	729	104	624	1	945	542	372	32	286	83	178	25

APPENDIX TABLE 26.—*Data for individual subjects—Continued*

State, subject code number, and period	Calcium				Phosphorus				Magnesium			
	Intake	Urine	Feces	Balance	Intake	Urine	Feces	Balance	Intake	Urine	Feces	Balance
NEBRASKA—Continued 305: A----- B----- C----- D----- CD----- E----- F----- EF----- G----- H----- GH-----	$Mq.$ 1, 187 718	$Mq.$ 213 189	$Mq.$ 737 419	$Mq.$ 237 110	$Mq.$ 1, 550 959	$Mq.$ 878 740	$Mq.$ 394 203	$Mq.$ 278 16	$Mq.$ 302 260	$Mq.$ 118 120	$Mq.$ 115 85	$Mq.$ 69 55
	725	198	304	223	938	607	175	156	277	123	70	84
	732	207	750	-225	946	680	465	-199	271	137	179	-45
	728	202	527	-1	942	644	320	-22	274	130	124	20
	725	218	476	31	958	649	305	4	283	125	122	36
	729	209	381	139	953	603	226	124	267	120	119	28
	727	214	428	85	956	626	266	64	275	123	120	32
	744	164	333	247	947	693	193	61	287	133	85	69
	718	173	817	-272	946	584	477	-115	284	108	193	-17
	731	168	575	-12	946	638	335	-27	286	121	139	26
	1, 001	190	437	374	1, 461	825	318	318	301	79	123	99
	718	208	743	-233	959	593	532	-166	260	99	215	-54
306: A----- B----- C----- D----- CD----- E----- F----- EF----- G----- H----- GH-----	725	208	421	96	938	513	333	92	277	102	139	36
	732	218	399	115	946	495	348	103	271	93	129	49
	728	213	410	106	942	504	340	98	274	98	134	42
	724	200	453	71	957	589	358	10	283	101	149	33
	728	184	316	228	952	580	244	128	267	100	96	71
	726	192	384	150	954	584	301	69	275	100	123	52
	743	220	589	-66	946	505	511	-70	287	113	185	-11
	715	214	1, 086	-585	944	484	932	-472	284	94	353	-163
	729	217	838	-326	945	494	722	-271	286	104	269	-87
	1, 080	218	755	107	1, 445	892	485	68	305	107	162	36
	718	151	743	-176	959	709	491	-241	260	117	183	-40
	725	163	462	100	938	685	294	-41	277	114	130	33
307: A----- B----- C----- D----- CD----- E----- F----- EF----- G----- H----- GH-----	732	145	589	-2	946	649	371	-74	271	112	163	-4
	728	154	526	49	942	667	332	-58	274	113	147	14
	724	163	549	12	957	670	312	-25	283	110	158	15
	729	172	613	-56	953	632	360	-39	267	125	167	-25
	726	168	581	-22	955	651	336	-32	275	118	162	-5
	744	154	695	-105	947	632	353	-38	287	125	174	-12
	716	140	394	182	945	636	247	62	284	109	114	61
	730	147	544	38	946	634	300	12	286	117	145	24



APPENDIX TABLE 26.—Data for individual subjects—Continued

State, subject code number, and period	Calcium				Phosphorus				Magnesium			
	Intake	Urine	Feces	Balance	Intake	Urine	Feces	Balance	Intake	Urine	Feces	Balance
OKLAHOMA—Continued												
403:												
A-----	Mg. 1, 130	Mg. 281	Mg. 1, 013	Mg. -164	Mg. 1, 540	Mg. 754	Mg. 425	Mg. 361	Mg. 390	Mg. 73	Mg. 236	Mg. 81
B-----	807	305	527	-25	901	584	240	77	251	87	174	-10
C-----	831	251	589	-9	941	584	278	79	244	80	210	-46
D-----	834	220	364	250	933	550	182	201	252	80	131	41
CD-----	832	236	476	120	937	567	230	140	248	80	170	-2
E-----	833	261	635	-63	920	516	270	134	180	82	185	-87
F-----	835	225	545	65	918	438	251	229	180	75	179	-74
EF-----	834	243	590	1	919	477	260	182	180	78	182	-80
G-----	827	298	522	7	912	578	246	88	280	86	186	8
H-----	833	188	461	184	940	482	276	182	283	93	198	-8
GH-----	830	243	491	96	926	530	261	135	282	90	192	0
404:												
A-----	770	168	1, 093	-491	1, 130	604	613	-87	350	66	221	63
B-----	806	376	359	71	901	392	198	311	251	86	99	66
C-----	827	155	375	297	939	352	163	424	242	71	78	93
D-----	831	157	913	-239	931	382	598	-49	251	79	234	-62
CD-----	829	156	644	29	935	367	380	188	246	76	156	16
E-----	846	155	768	-77	937	448	450	39	278	99	188	-9
F-----	834	218	544	72	938	420	302	216	278	116	143	19
EF-----	840	186	656	-2	938	434	376	128	278	108	165	5
G-----	823	155	985	317	893	418	534	-59	186	82	186	-82
H-----	831	86	503	242	931	374	302	255	191	78	108	5
GH-----	827	121	744	-38	912	396	418	98	188	79	147	-38
405:												
A-----	1, 150	106	804	240	1, 570	640	395	535	336	62	140	134
B-----	806	139	933	-266	901	386	515	0	251	77	195	-21
C-----	823	160	834	-171	936	404	347	185	239	72	185	-18
D-----	825	124	781	-80	927	356	441	130	247	70	203	-26
CD-----	824	142	808	-126	932	380	394	158	243	71	191	-22
E-----	822	189	739	-106	913	414	382	117	173	71	135	-33
F-----	825	144	786	-105	911	382	453	76	173	66	143	-36
EF-----	824	167	763	-106	912	398	418	96	173	68	139	-34
G-----	815	115	595	105	904	422	325	157	273	82	169	22
H-----	821	108	738	-25	933	426	379	128	276	88	222	-34
GH-----	818	112	666	40	918	424	352	142	274	84	196	-6

406:	A	1,000	189	953	-142	1,140	614	431	95	196	80	191	-75
	B	806	222	419	165	901	484	180	237	251	90	104	57
	C	827	256	719	-148	939	478	279	182	242	94	159	-11
	D	831	232	481	118	931	554	209	168	250	31	124	31
	CD	829	244	600	-15	935	516	244	175	246	94	142	10
	E	846	205	529	112	937	472	229	236	277	116	135	26
	F	837	205	709	-77	939	542	311	86	280	113	198	-31
	EF	842	205	619	18	938	507	270	161	278	114	166	-2
	G	829	145	533	151	897	548	218	131	189	97	99	-7
	H	834	162	563	109	933	494	252	187	193	91	104	-2
407:	GH	832	154	548	130	915	521	235	159	191	94	101	-4
	A	1,150	151	967	32	1,590	620	496	474	334	61	171	102
	B	806	161	817	-172	901	378	487	36	251	63	160	28
	C	827	107	683	37	939	346	429	164	242	68	169	5
	D	831	132	818	-119	931	378	466	87	251	74	206	-29
	CD	829	120	750	-41	935	362	448	126	246	71	187	-12
	E	833	149	813	-129	920	402	444	74	180	84	157	-61
	F	835	210	702	-77	918	334	407	177	179	86	141	-48
	EF	834	179	758	-103	919	368	425	126	180	85	149	-54
	G	827	124	652	51	912	422	384	106	281	81	174	26
408:	H	832	103	677	52	939	390	432	117	283	78	187	18
	GH	830	114	664	52	926	406	408	112	282	80	180	22
	A	1,350	145	793	412	1,760	816	720	224	400	83	184	133
	B	806	228	526	52	901	508	264	129	251	95	100	56
	C	828	117	732	-21	939	414	377	148	242	84	159	-1
	D	831	114	626	91	931	390	378	163	251	89	145	17
	CD	830	116	679	35	935	402	378	156	246	86	152	8
	A	930	168	988	-226	1,310	740	424	146	288	81	151	56
	B	806	165	874	-233	901	470	445	-14	251	90	179	-18
	C	827	165	463	199	939	388	248	303	242	103	115	24
409:	D	832	175	695	-38	932	462	34	34	251	106	183	-38
	CD	830	170	579	80	936	425	342	168	246	104	149	-7
	E	832	129	697	6	920	490	317	113	180	101	107	-28
	F	835	132	546	157	918	458	277	183	179	99	95	-15
	EF	834	130	622	82	919	474	297	148	180	101	101	-22
	G	827	272	552	3	912	480	252	180	281	111	116	54
	H	833	234	593	6	940	463	413	64	283	107	195	-19
	GH	830	253	573	4	926	472	332	122	282	109	155	18









